Power Generation

TECHNOLOGY DEPARTMENT and POWER PLANT ENGINEERING

For ALL Power Engineers • Steam, Electricity and All Other Power Engineering Services

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COMPLETE CONTENTS

★ **Waterside Completes Its Topping Program** 54
By H. Knecht
Mechanical Muscles—Intelligent Instruments 58
Tacubaya Diesels Burn Heavy Fuel Oil 59
Locating Grounds on 480-v 3-phase Delta Systems 60
By B. G. Forbes
More Power for California People 61
New Maintenance Method Cuts I.D. Fan Outage from 1 Week to 16 hr at Delray 62
Why Continue These Practices? 64
By A. G. Christie
Extractor for Economizer Tube Plugs 65
By G. Amador de los Rios
New High-Voltage Engineering Laboratory at Pittsfield 66
Filters as Fuel 67
POWER GENERATION News Reel 68
★ **Comparison of Conventional and Sludge-Blanket Softeners at a Firestone Plant** 70
By R. E. Burns and John Wood
Basic Power Plant Figuring 74
By William H. Engelman
Steam and Power for Electro-Motive 76
Atomics Digest 78
Vaporization Cooling of Large Electrical Machines 82
How to Eliminate Static from Shafting 88
By W. E. Warner
Refrigeration and Power for Alford's New 17-Acre Warehouse in Dallas 90
★ **Take a New Look at Your Industrial Power Plant** 94
By C. D. Gibbs

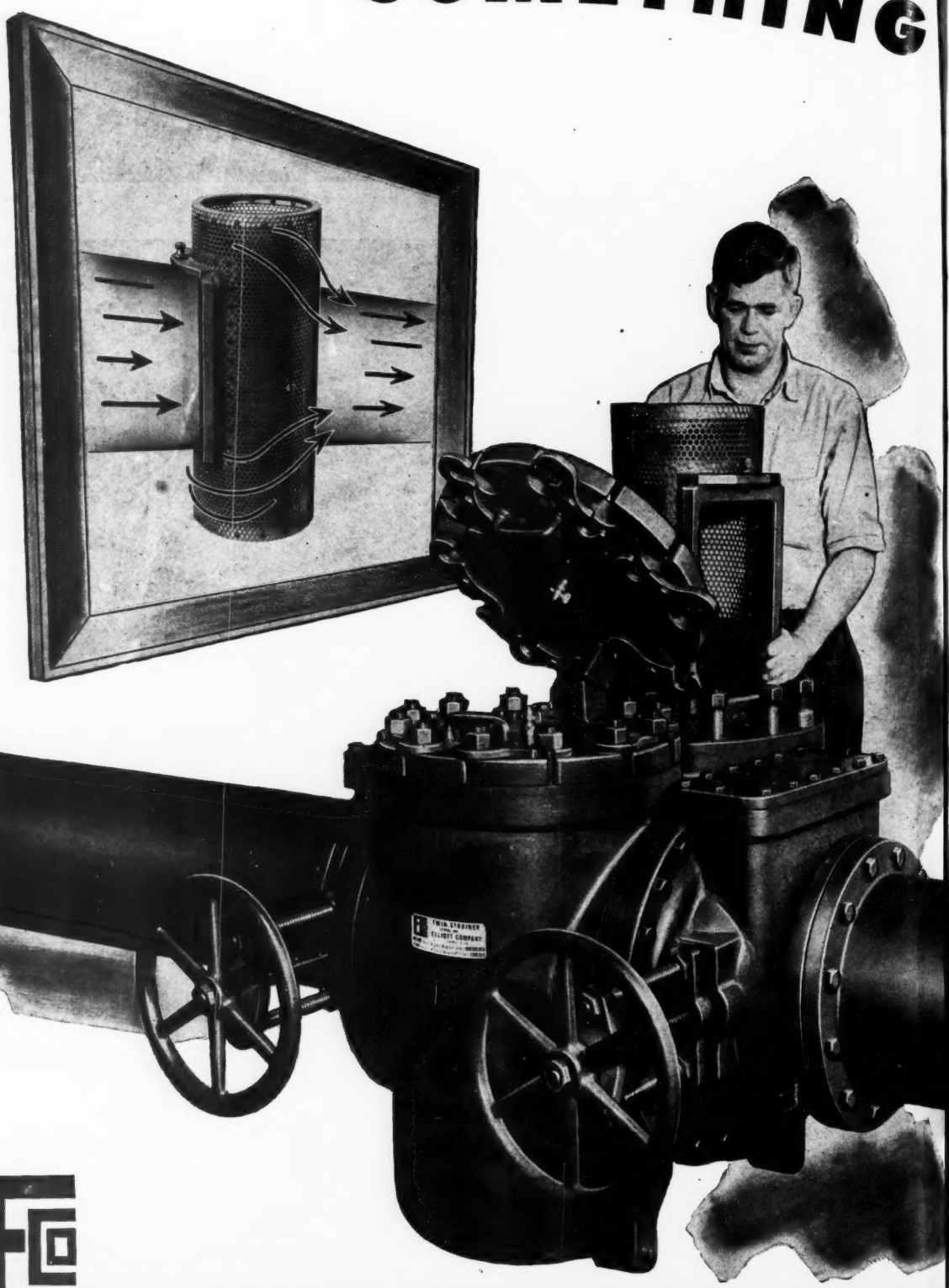
Regular Departments

Notes on This Issue 5
Engineers' Preview 7
Questions and Answers 79
What Operating Data Should Be Logged for a 1250-kw Condensing Turbine Generator?
How Much Phase Unbalance Can a Generator Stand?
Can We Use a Cadmium Storage Battery in a Power Plant?
What Treatments Prevent Scale and Corrosion in Drinking Water Systems?
Helpful Bulletins 35
New Equipment News 42
Construction News 132
Obituaries 100
Coming Events 100
Catalog Library 114
New Engineering Books 128
Letters to the Editors 53
Additives
Frozen Coal
Grounding Neutrals
Soldering Iron Heat

SEPTEMBER
1949

City ..... State .....

SOMETHING



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Published Monthly by
TECHNICAL PUBLISHING CO.
53 W. JACKSON BLVD.
CHICAGO 4, ILL.

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Subscription Information—Published Monthly. Prices: United States and Possessions one year $10.00, Canada one year $11.00. Other countries one year $12.00. Single copies $1.00. Changes of address should give both old and new address and reach us by 15th of month to be effective with following month's issues. The Annual Index is furnished as a part of the December issue.

Contents of back issues of Power Plant Engineering and Power Generation will be found in both the Industrial Arts Index and the Engineering Index on file in Public Libraries.

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Power Generation

September 1949

VOLUME 53—NUMBER 9

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Notes on This Issue

Waterside Completes its Topping Program

Waterside is one of New York's oldest generating stations. In the May issue we presented an article by R. T. Roberts of Consolidated Edison Co. describing the boiler room part of this topping program. In this second article Mr. H. Knecht, Mechanical Plant Engineer, takes up the turbine-generator.

The work involved a number of unique features such as installing the direct-contact extraction feedwater heaters on top of the electric generators of the low pressure turbines.

A complete flow diagram of the steam, feedwater and auxiliary system is of special interest.

A New Look at Industrial Power Plants

Here is an article by a consulting engineer which will help the power man in a medium or small industrial plant show management the great potential savings possible in taking full advantage of modern methods and equipment. In plants built under cost conditions of several years ago general management executives frequently do not realize that equipment is available for efficiencies undreamed of when the plant was built and they should make full use of the knowledge of their own engineers and the services of consulting engineers to improve their cost picture.

Why Continue These Practices?

Professor A. G. Christie is an old friend to many of us. For many years Professor of Mechanical Engineering at Johns Hopkins University and now Professor Emeritus; a past president of ASME; consultant on many large power projects; it is gratifying that he selected POWER GENERATION in which to make this plea for better engineering. Professor Christie lists a number of poor power plant practices and points out in each case why they should be discontinued.

Delray

Many of you remember the history-making series we ran on Delray Station of Detroit Edison Company ten years ago. This series was later printed as a 100 page book. Delray is still up there leading the way in many developments, like this new maintenance method shown by the picture story in this issue which reduces fan outage by 40%.

A 17 Acre Warehouse

That's a lot of warehouse and requires a lot of refrigeration and power service. The same kind of equipment is used in smaller plants but when seen on such a scale as this it is impressive.

At the Alford warehouse in Dallas, described in this issue, the power equipment ranges all the way from natural-gas-burning internal combustion engines, ammonia compressors, and a.c. generators through the complete electrical distribution system. Piping is extensive and involves problems of expansion and contraction. The building is nearly a third of a mile long, all on one story and is refrigerated by unit coolers. Cooling water for the ammonia compressor condensers requires two large cooling towers and an extensive water-pumping system. Obviously the men who design, select and operate power and refrigeration equipment in a layout like this are power engineers of a high caliber.

Package Sub-Stations

According to the Federal Power Commission electrical distribution accounts for 40% of the total national investment in power systems. The package substation which is a group of highly standardized elements and can be assembled in a variety of combinations, should be a vital factor in the reduction of distribution costs.

Every power engineer concerned with distribution and transmission will find useful this discussion of the time and money-saving advantage and flexibility of package substations.

Tacubaya Diesels

South of the Border, down Mexico way, they have something besides dark-eyed senoritas and bull fights. For instance, six of the largest Diesel engines ever built in the Western Hemisphere—8350 hp each. These big Diesels burn heavy oil (Bunker C) instead of standard Diesel fuel oil so we give details on fuel handling methods required.

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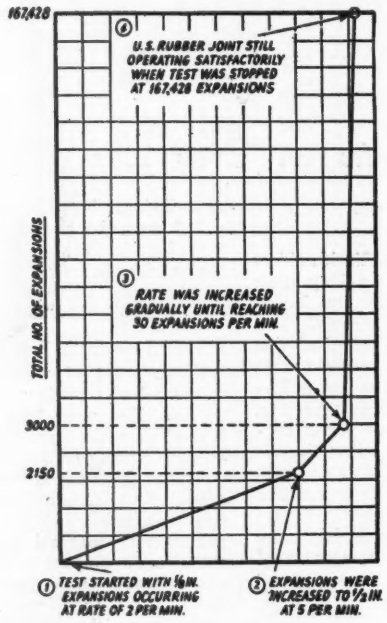
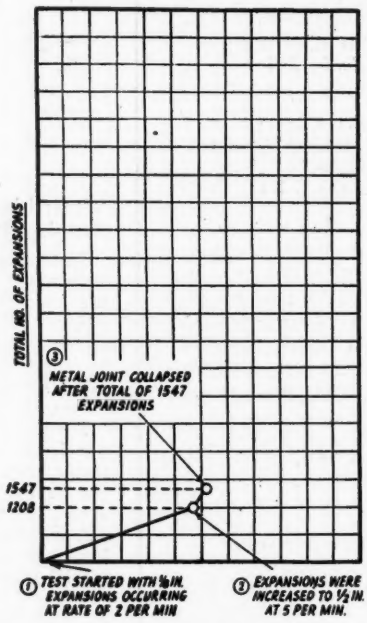
Vibration tests show U. S. Rubber Expansion Joint withstands over 100 times more vibration cycles than a metal joint

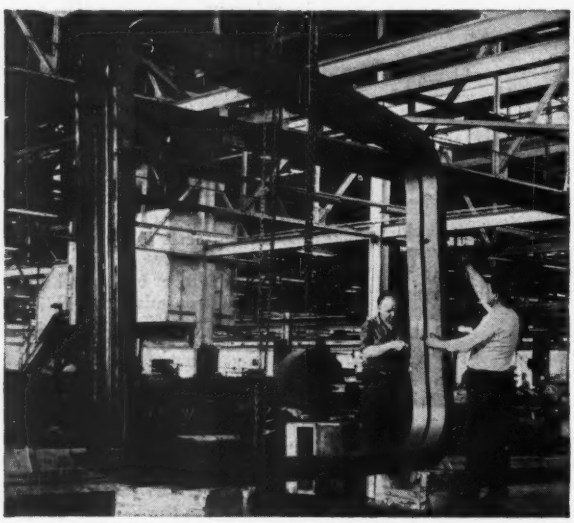

167,428
④ U.S. RUBBER JOINT STILL OPERATING SATISFACTORILY WHEN TEST WAS STOPPED AT 167,428 EXPANSIONS
TOTAL NO. OF EXPANSIONS
③ RATE WAS INCREASED GRADUALLY UNTIL REACHING 30 EXPANSIONS PER MIN.
3000
2150
① TEST STARTED WITH 1/8 IN. EXPANSIONS OCCURRING AT RATE OF 2 PER MIN.
② EXPANSIONS WERE INCREASED TO 1/2 IN. AT 5 PER MIN.

Test of U. S. Rubber Expansion Joint


TOTAL NO. OF EXPANSIONS
③ METAL JOINT COLLAPSED AFTER TOTAL OF 1547 EXPANSIONS
1547
1208
① TEST STARTED WITH 1/8 IN. EXPANSIONS OCCURRING AT RATE OF 2 PER MIN
② EXPANSIONS WERE INCREASED TO 1/2 IN. AT 5 PER MIN.

Test of Metal Joint

To determine comparative endurance, a U. S. Rubber Expansion Joint and a metal joint were subjected to the vibration tests described in the above charts. The metal joint collapsed after 1547 cycles while the rubber joint was still operating satisfactorily after 167,428 cycles. A rigorous test for shock also demonstrated the superiority of the U. S. Rubber Expansion Joint.



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ENGINEERS' PREVIEW

AGE-OLD MYSTERIES surrounding the single cell of living matter are broken into by investigators at Columbia University, using a new, highly-complex machine designed by members of the Department of Zoology. Constructed on a principle of photo-metric chemical analysis, the machine permits the Columbia cytologists to determine the relative concentrations of such substances as nucleic acids and proteins in a single cell nucleus—a structure of a few ten-thousandths of an inch in diameter. At this cellular level, it was pointed out, the amounts of the substances detected by the photo-metric apparatus are "fantastically" small. It can be shown that the amount of nucleic acid in a single cell nucleus is only a few trillionths of a gram, less than one-trillionth of an ounce. Professor Arthur W. Pollister, who directed the construction of the apparatus, explained that the various concentrations in the cell are discovered by measuring with highly sensitive photo-electric tubes the proportion of light absorbed by the chemical components within the nucleus of the cell.

★ ★ ★

NEW TYPE of electrical engine-pressure-indicating system for research and testing is proposed in a report now available to the American public, the Office of Technical Services of the U. S. Department of Commerce has announced.

The report, prepared at the David Taylor Model Basin of the Navy Department, provides a review of engine-pressure instruments. It includes an as-yet untested plan for a high-frequency ("H-F") transducer, or pickup element, in which indications are derived from circuit resonance.

According to the report, mechanical devices for indicating engine-pressure are inadequate for measuring as great a range of engine speeds and operating conditions as may be desirable for current research in internal-combustion engines, steam engines, compressors and fuels. In addition, suitable electrical devices should be simpler to operate, more reliable, and easier to maintain.

Advantages and disadvantages of electrical engine-pressure indicators are discussed. Several possible variations of the proposed "H-F transducer" are discussed, with comments on their advantages and the associated equipment necessary.

The report also includes appendices dealing with a pressure transducer developed for recording minute changes in a hydrostatic head; and with the application of frequency-modulation techniques to transducers.

PB 96928, *An Electrical Engine-pressure-indication Device*, 29 pages including drawings and graph, sells for $2 in microfilm, $3.75 in photostat. Orders should be addressed to the Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C., accompanied by check or money order payable to the Librarian of Congress.

★ ★ ★

NEW ALLOY steel for service at operating temperatures as low as —423 F has been announced by Lebanon Steel Foundry. An austenitic cast ferrous alloy containing 19.50 per cent chromium and 9 per cent nickel, among other alloying constituents, the steel is believed to have particular usefulness for exacting requirements of the oil, chemical and other processing industries. It already has been used effectively in the production of steel castings for high-pressure equipment at —298 F in storage facilities for liquid oxygen used as a propellant for rocket engines.

Tensile strength of the particular cast austenitic alloy varies inversely with temperature, and in direct relationship with hardness. Ductility is lowered somewhat, but not in proportion to the increase of tensile strength, which is estimated to be approximately 200,000 psi at —423 degrees, with retention of adequate strength factors and resistance to embrittlement. Paradoxically, the same (L)-22 alloy adapted for sub-zero service also is being used sucessfully where exacting heat-resistant characteristics are needed at extremely high operating temperatures, as in some jet-engine components, turbo-supercharger parts, and other gas turbine uses.

★ ★ ★

FEDERAL PROSE—How to Write in and/or for Washington by James R. Masterson and Wendell Brooks Phillips, with grin-generating cartoons by Jo Thoms, has recently been published by The University of North Carolina Press at Chapel Hill. The book, which is pure satire and consequently contains some well-pointed barbs, is stated to be for American citizens who aspire to serve their fellow men by writing the language that is written and sometimes spoken in the Nation's Capital, and thus to qualify themselves as instruments by which the power and benevolence of the Federal Government are brought to bear upon the American people.

The book is divided into several sections, the first of which discusses in detail the question—Have you the courage to write Federal prose? Next the authors ask—Have you any aptitude for writing Federal prose? For example: Do you like pastel shades? Do you write "prior to 1900" in preference to "before 1900"? A whole series of questions like this constitutes an aptitude test.

Next—can you sense the spirit of Federal prose? In English you might say, "Too many cooks spoil the broth." Federal prose, however, would render it thus:—"Undue multiplicity of personnel assigned either concurrently or consecutively to a single function involves deterioration of quality in the resultant product as compared with the product of the labor of an exact sufficiency of personnel."

Next you have to understand the rules of Federal prose. You would never say say, for example, "hens lay eggs." In Federal prose you would say—"Egg-laying characterizes hens. Hens are typically oviparous. Hens ovulate, though not continuously and not without exception. Gallinaceous ovulation is effected only by hens." You would never say, as in English, "Show your pass," but in Federal prose—"The display of your entrance permit is mandatory," and so on and on.

The glossary at the end of the book is a prize. It defines English words in terms of Federal prose. For example, in Federal prose you must never use I or We. "These expressions offend in both their egotism and their suggestion of unsocialized orientation." Substitute either "the undersigned" or a passive construction, thus:—"Appreciation is desired to be expressed for the permission granted in your communication of the 17th instant." (Remember? "Illumination is required to be extinguished before these premises are closed to business.")

The authors are a couple of refugees from war-time government jobs who managed to escape with their sense of humor intact. The book, they say, is not for farmers, retailers, taxpayers and other American citizens who must read and obey what comes from Washington. They need a book; but this is not it.

However, this one will keep your cheek muscles twitching for many minutes and occasionally will produce a "yuk" or even a b--ly laugh — excuse us: a cacchination involving alternate contractions and expansions of the walls of the abdomen.

MARRIAGE of medicine and engineering in submarines is leading to some interesting technical offsprings; so Captain Thomas L. Willmon of the U. S. Navy Medical Corps told members of the ASME at its Spring Meeting in New London. He pointed out that many engineering developments have been largely the result of submarine requirements: the lead acid storage battery received great impetus, as did the Diesel engine. Another important set of problems arises from the wartime development of the submarine for long submergence or surface operation in tropical waters. Under these conditions air conditioning is mandatory, not only for the personnel but also to protect delicate electrical and electronic gear.

Still another new set of problems arises from the use of the snorkel. This is a device that permits submerged submarine operation with engines instead of batteries. The snorkel is a rigid, streamlined, retractable housing containing two air ducts large enough to supply intake air and serve as engine exhaust. The snorkel is long enough so that the submarine can run at periscope depth. The top of the snorkel is fitted with a water-closing valve, actuated when the snorkel head goes under water through loss of depth control or wash of the seas. Since the engines continue to operate and draw air from the boat, the closure of the snorkel valve reduces the pressure inside the submarine to a point such that an automatic switch will stop the engines. In a seaway there may be a continuous and rapid fluctuation of ambient pressure induced by frequent closure of the head valves.

As a result, submariners have become physiologically like aviators. A slightly decreased pressure occurs in the boat during all snorkelling. When the head valve closes, the personnel is subjected to a rarefied atmosphere reaching the order of 7000 ft altitude. When the head valve opens, air at atmospheric pressure flows into the boat at a rate comparable to a vertical dive of about 7000 ft per minute. The physiological effects of these factors involve the middle ear and sinuses.

Another problem is the development of protective clothing for topside watch-standers on submarines, who have always been wet in inclement weather.

Still another problem is that, when the craft remains submerged for days on end, with only the snorkel tube above the surface, there is no difference between night and day. Boredom of the personnel may become a problem. One method of counteracting this is what the Navy calls "Operation Rainbow"—use of color and light conditioning of the submarine's interior to cause a change of appearance on walking from one compartment to another. Captain Willmon pointed out, however, that there was no intention to atomize Tabu or My Sin throughout the compartments.

★ ★ ★

INSTRUMENT to measure radiation in air more than 70 miles above the earth's surface has been reported by Dr. Severin Raynor, senior scientist at Armour Research Foundation of Illinois Institute of Technology.

Scientists plan to measure heat radiated from the sun, the earth and space with a gyro stabilized sphere which will be ejected from a rocket on its way up at a speed of about 1800 mph. The metal sphere will contain three gyroscopes, fourteen temperature sensors, and a camera unit for recording the data to be studied later. Describing space 400,000 ft high, Dr. Raynor said it is dark and hot (about 180 F). An almost complete vacuum prevails and weight decreases.

The project at the Foundation is being sponsored by the U. S. Air Force, Air Materiel Command.

VOICE COMMANDS OPERATE bi-lingual elevator, as demonstrated to conferees at the recently held Building Owners and Managers Association convention in Montreal, Quebec, Canada—the French and English speaking city.

The elevator operator didn't pull a handle, or push a button, or even touch a button. But when he called out "going up" or "monter" into a microphone, the elevator doors closed immediately and the car rose to its destination. He called out "down please" or "descendre" and the car returned to its starting position.

The elevator car, a model, one foot high, that responds to voice commands in English or French, was built by the Westinghouse Elevator Division. The company does not plan to build voice-controlled elevators, but built the model to demonstrate the "uncanny alertness" engineers are building into modern elevator controls.

★ ★ ★

OVER 100,000 different kinds of playthings were displayed at the recent American Toy Fair in New York. In recent years, toy manufacturers and child psychologists have stressed toys that tend to bring out a child's natural abilities and prepare him for a career through play. Toys are tested for age interest, fun value, and safety before they are placed on the market; this pre-selection is a valuable guide for adults. Many toys, points out the *Industrial Bulletin*, are miniatures of things the child encounters in everyday life, or are small-scale models of adult equipment. For the young housewife there is an electric vacuum cleaner that picks up dust and dirt, television sets which combine the principles of the magic lantern and the movie projector, and a toy telephone that answers back. Dolls become more lifelike every year; the latest model has a treated nylon wig that can be shampooed and waved over and over.

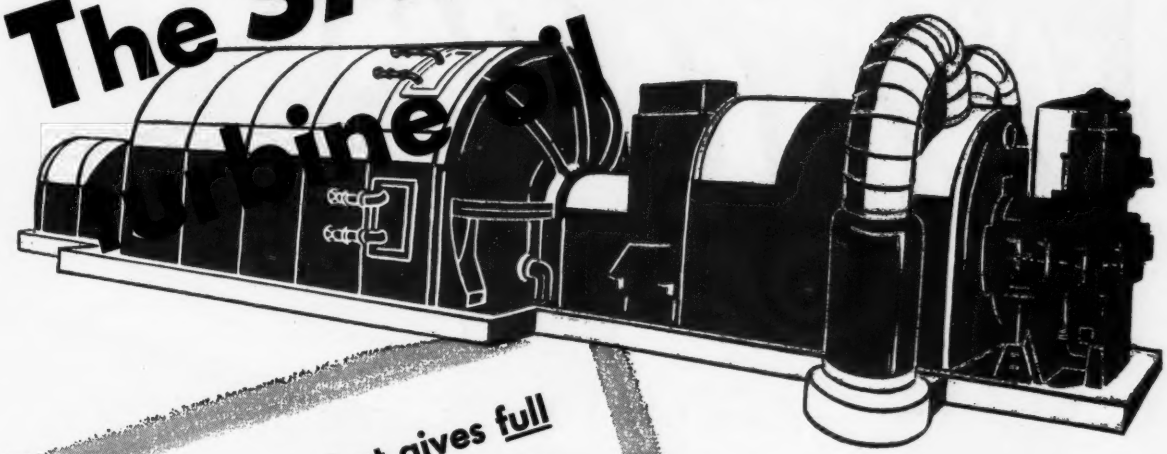
The latest news in electric trains is a cattle car that loads and unloads cattle automatically, and a baggage car that picks up and delivers mail pouches simultaneously. There are new twin-motored Diesel engines, switch engines, and an electronic rectiformer to give trains smoother operation and positive control.

Among the "things-to-make" toys is an extrusion press for making bricks from water-free modeling clay. Six nozzles make it possible to extrude logs, round, square or flat tiles, and interlocking bricks, which can be baked for a permanent finish. There are hydro-electric kits for building canals and power plants, and chemistry sets now contain a sample of uranium.

★ ★ ★

FIRST CONTINUOUS shale-oil refinery in this country, the new 200-barrel-a-day experimental unit near Rifle, Colo., has been put "on stream" without difficulty. A highly flexible, continuous unit, the refinery is designed to produce gasoline, Diesel fuel, heating fuels, and fuel gas from crude shale oils extracted at the Bureau's Oil-Shale Demonstration Plant. It was built under contract with the Refinery Engineering Co. of Tulsa, Okla., at a cost of $244,912. All of the Bureau's installations near Rifle—the mine, retorts, and refinery—will be on exhibition September 20 and 21, the midway point in a month-long, oil-shale mining demonstration. Guided tours are planned on both days, together with a public dinner meeting at Glenwood Springs on the night of Tuesday, September 20. As designed and built, the new experimental refinery is of the minimum size that will provide the desired information about shale-oil refining, including the operational characteristics and costs.

The SAFEST turbine oil



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OPERATORS using *Texaco Regal Oils (R&O)* have an extra margin of safety because—1) powerful inhibitors protect against the formation of rust and sludge, and 2) special processing checks foaming. Result: turbine lubricating systems stay clean…bearings get full lubrication at all times…governor action is instantly responsive.

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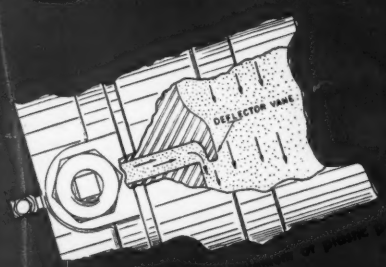

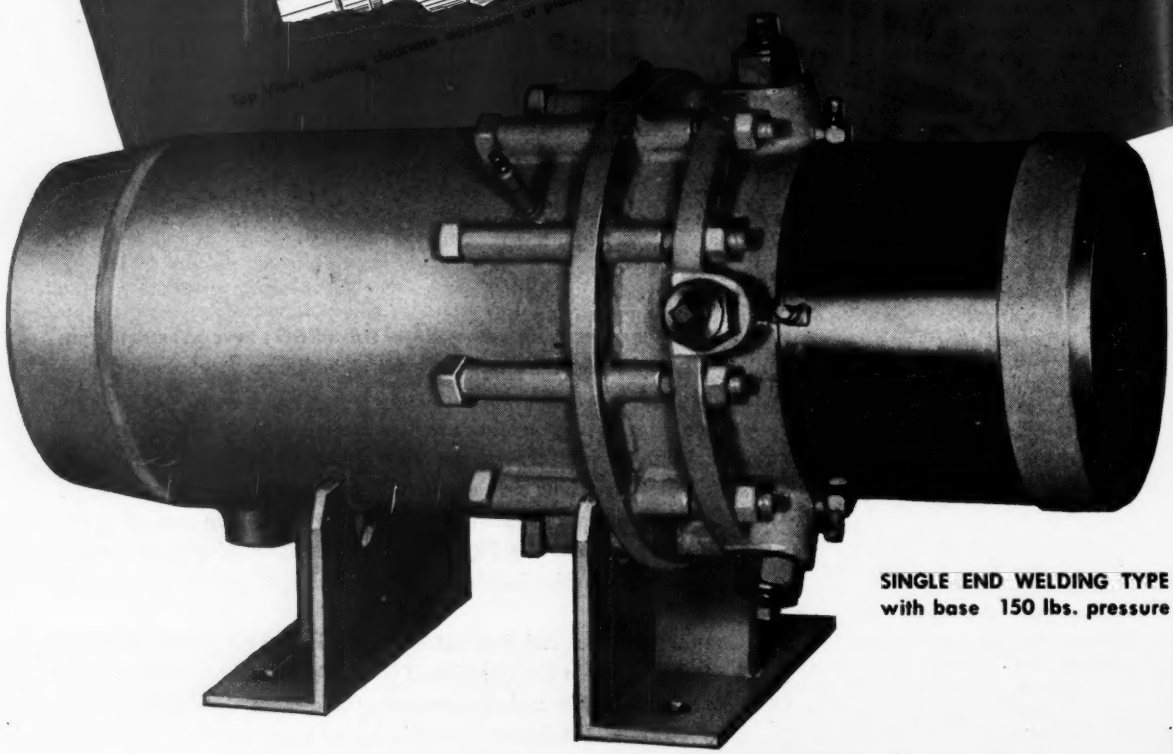

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with base 150 lbs. pressure

YARWAY

TOLEDO EDISON CHOOSES THE EXPANSION JOINT THAT IS *Serviced* UNDER FULL STEAM PRESSURE

Toledo Edison Company knows how to save on expansion joint maintenance. They use Yarway GUN-PAKT Joints—22 of them, ranging in size from 8″ to 14″ on their recent steam distribution extension.

GUN-PAKT Joints are serviced under full steam pressure . . . no costly shutdowns or heating interruptions. For repacking, simply insert a packing plug, twist a wrench, and the job's done! Special Alemite fittings provide for proper lubrication. Maintenance costs are low. One user says only 65 cents per year per joint. Others claim less than that. But wherever steam is distributed, and expansion joints are used, the trend is toward GUN-PAKT.

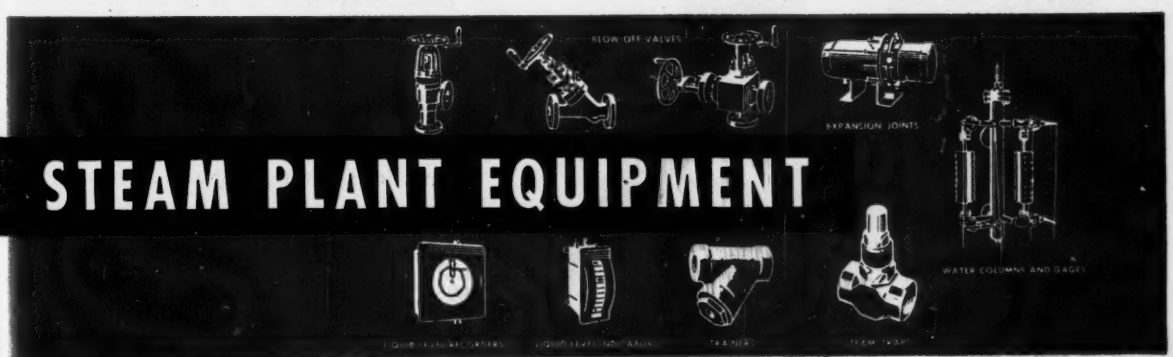
Read the GUN-PAKT story in Yarway's Bulletin EJ-1912. Write—

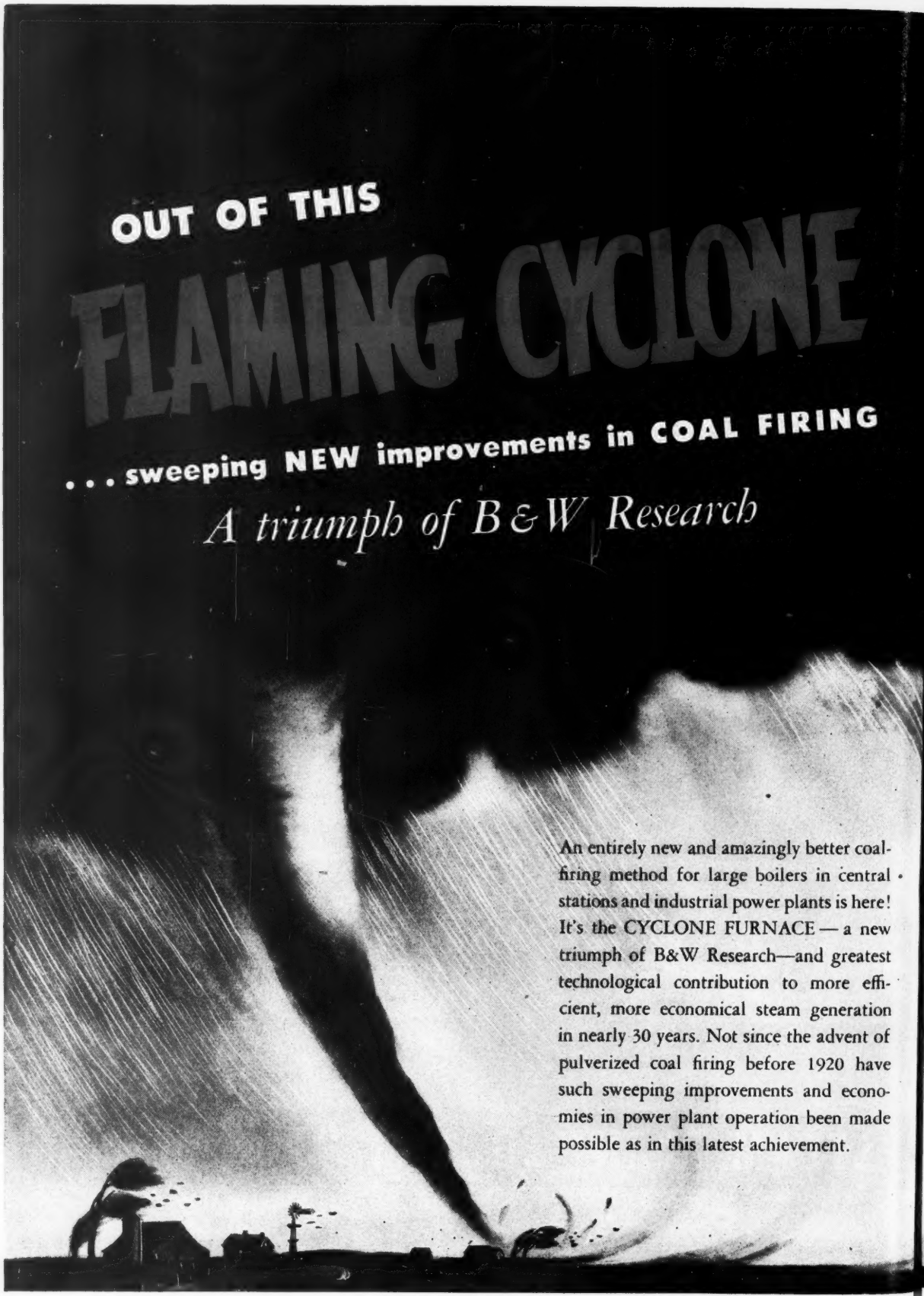
YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia 18, Pa.

8″ Gun-Pakt Joint on Toledo Edison line at Manhole No. 12.

Yarway Gun-Pakt Joint on Toledo Edison Jackson Avenue line.

14″ Gun-Pakt Joint in Toledo Edison No. 1 Manhole.

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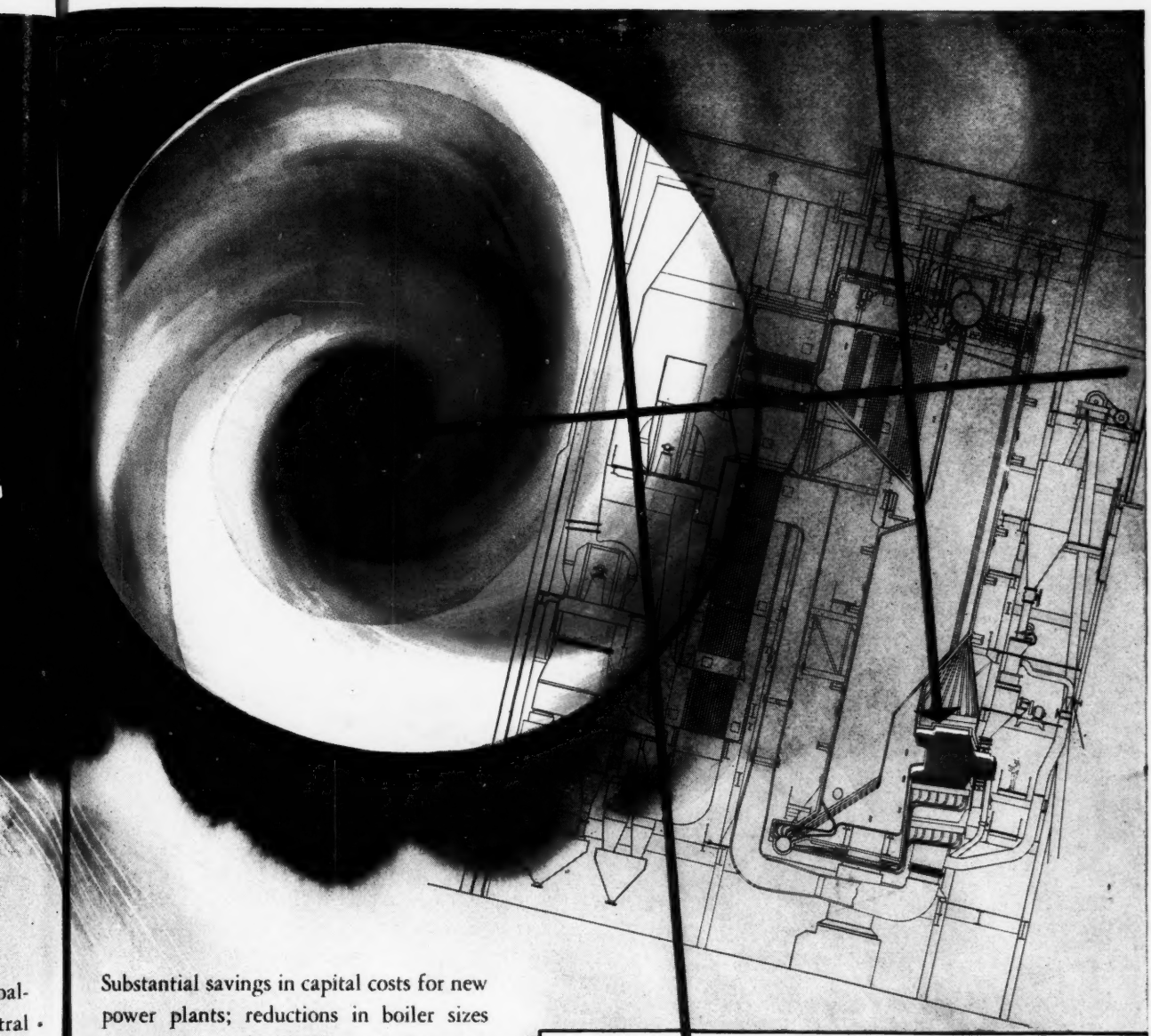
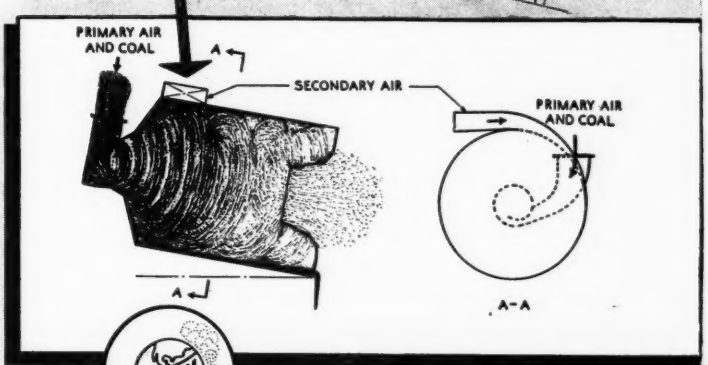
. . . sweeping NEW improvements in COAL FIRING
A triumph of B&W Research
An entirely new and amazingly better coal-firing method for large boilers in central stations and industrial power plants is here! It's the CYCLONE FURNACE — a new triumph of B&W Research—and greatest technological contribution to more efficient, more economical steam generation in nearly 30 years. Not since the advent of pulverized coal firing before 1920 have such sweeping improvements and economies in power plant operation been made possible as in this latest achievement.



Substantial savings in capital costs for new power plants; reductions in boiler sizes and weights, and in building requirements; simplified ash handling; much less stack dust; elimination of large auxiliaries; less boiler maintenance . . . these are among the outstanding benefits in the wake of this revolutionary firing method. Thoroughly tried and tested for several years in actual service, the Cyclone Furnace has confirmed all advance claims with results that exceeded expectations.

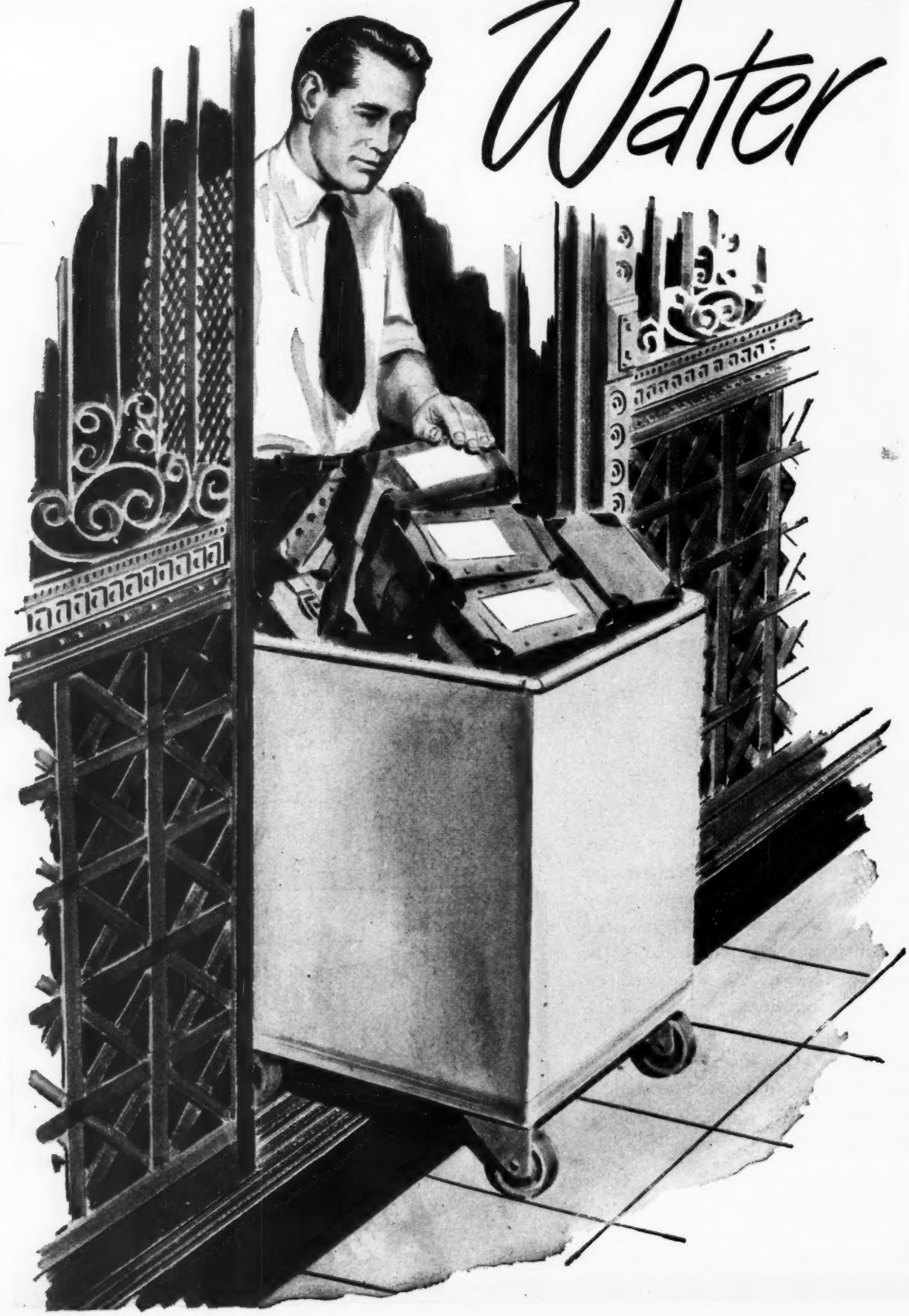


B&W

BABCOCK & WILCOX

G-353T

Water



Problems

on their way to solution

Water comes to Hall Laboratories from every corner of the country—raw water from wells and streams, water used in industrial processes, boiler water, waste water.

These water samples represent literally thousands of problems, for every water, every plant, every process, is a distinct problem which may require a thorough study of dozens of related factors before a complete solution is possible. And, of course, a solution is not "complete" unless it represents the most efficient and economic procedure *in that specific situation.*

Hall Service is able to provide complete solutions, because Hall is equipped to consider all of the water problems of an industrial plant *as a whole.* Water sources, water uses, waste recovery and disposal all come within the scope of Hall Service.

Hall analysis of your water problems goes far beyond the water itself. It involves a thorough study of all plant operations involving water. Detailed knowledge of the interrelation of water, plant processes, and equipment has, in many instances, enabled Hall engineers to accomplish, by simple and effective procedures *at the right point*, results which might otherwise require expensive equipment.

This was the case, for example, in a power plant where there was corrosion of turbine blades. Carry-over of chloride in the steam was blamed and installation of an evaporator to supply distilled water for the whole system was recommended. The Hall engineer, however, traced the trouble down and found that, during stand-by, salt water from the barometric condenser hot well was being siphoned back to the turbine. Simple provisions to break the siphon ended the trouble.

In another plant, where purifying waste water before discharging it into a stream was the problem, installation of expensive oil-separation apparatus was planned. Here the Hall engineer showed how the oil contamination could be checked *at its source* with an equipment expenditure of less than $100.

Hall Laboratories offers *plant-wide water service* and invites correspondence concerning this service or any phase of industrial water conditioning. Address Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pennsylvania.

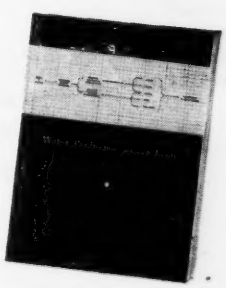
HALL LABORATORIES, INC.

(A Subsidiary of Hagan Corporation)

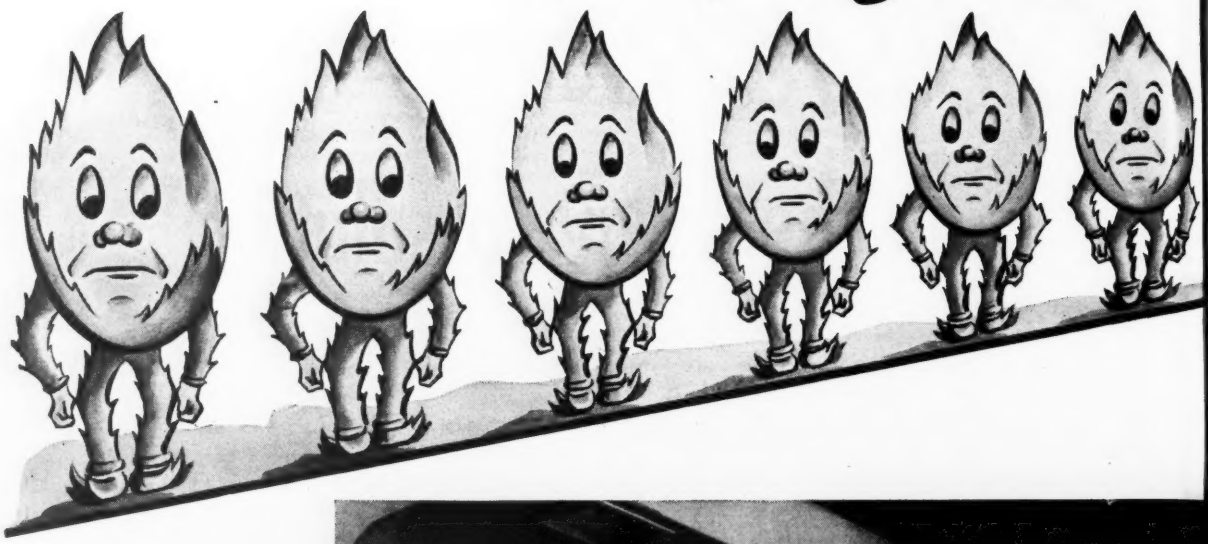
CONSULTANTS ON
INDUSTRIAL WATER TREATMENT
HALL SYSTEM OF BOILER WATER CONDITIONING
INDUSTRIAL WASTE RECOVERY AND DISPOSAL

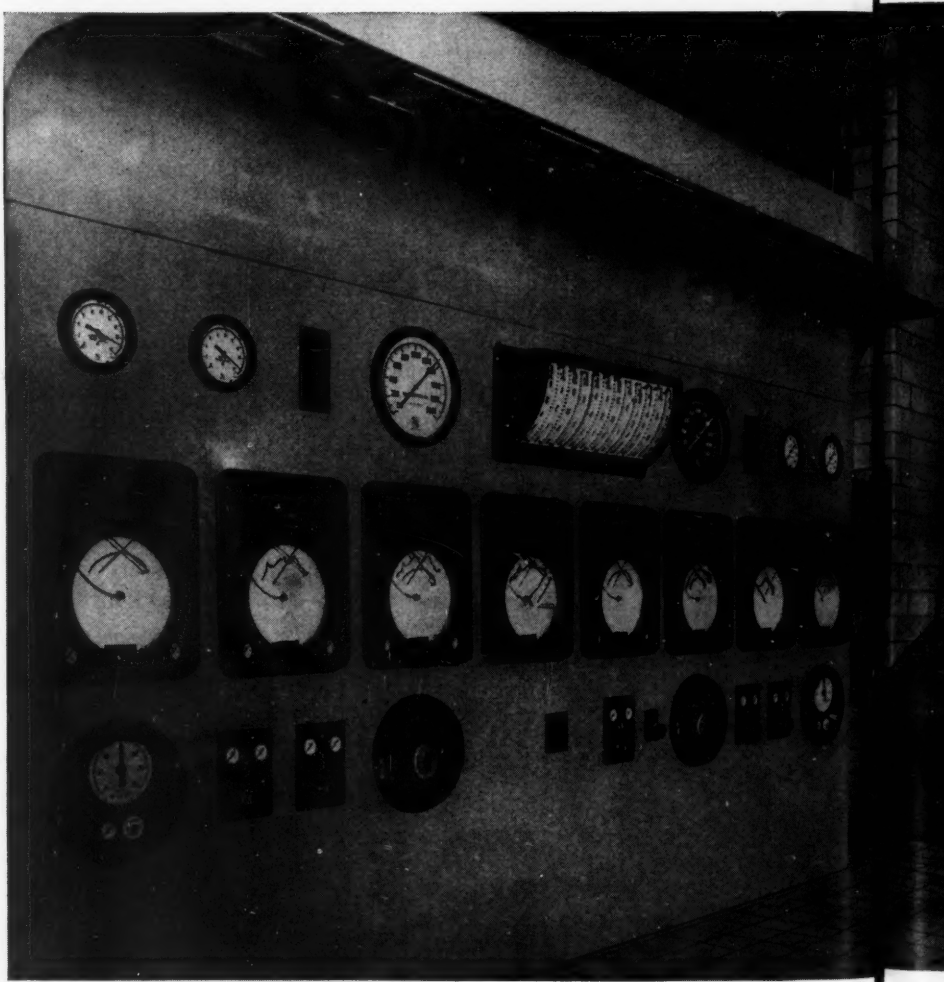
May we send you a copy of this Bulletin?

Reprints of eleven advertisements explaining the inter-relation of all water problems from selection of source to disposal of waste. If you would like a copy, just drop a postcard to Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.



Keeping Btu's





Bailey Boiler Control Panels for 200,000 lb per hour capacity, 880 psi, 900° F pulverized coal-fired boiler at the Hudson Steam Plant of Rockland Light and Power Company, Tomkins Cove, New York. All

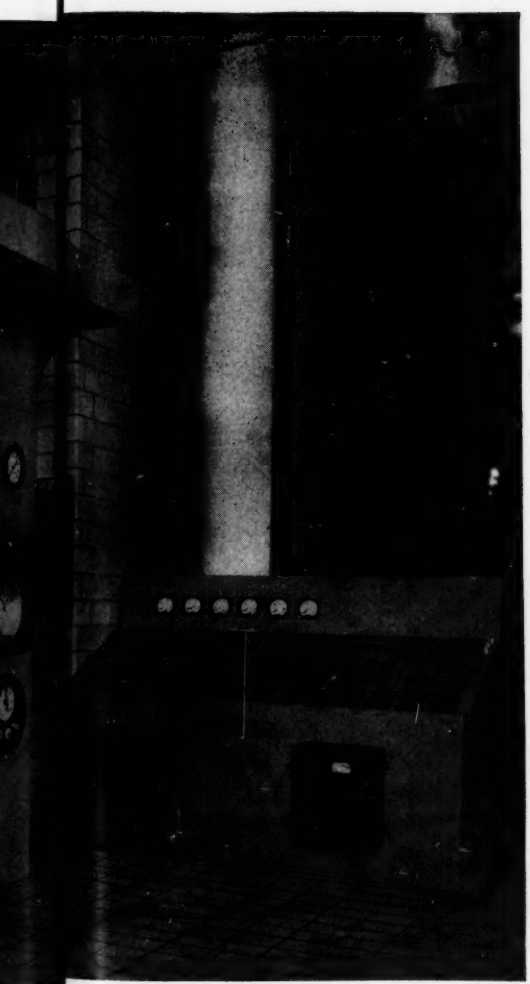
Boiler C
handlin

Milw

Branches in: Atlanta, Boston, Buffalo, Charlotte, Chicago, Cincinnati, Denver, Detroit, Houston, Kansas City, Los Angeles,

IN LINE

at Tomkins Cove



Boiler Controls are co-ordinated to insure efficient handling of the heat energy released in combustion.

● Optimum conditions in routine operation are provided for at the Hudson Steam Plant of Rockland Light and Power Company. This new station at Tomkins Cove, New York, keeps Btu's in line with a complete installation of Bailey Boiler Controls, all co-ordinated to work as a team in directing the efficient use of heat energy.

The installation includes:

Bailey Combustion Control

Bailey Three-element Feed Water Control

Bailey Steam Temperature Control

Bailey Coal-Air Temperature Control

Bailey Three-element Condensate Control.

It's easy to keep Btu's in line with co-ordinated controls engineered to fit your plant.

Call your local Bailey Engineer for recommendations on how meters and controls can help you to get more useable heat energy from your fuels.

A-108-2

BAILEY METER COMPANY

1040 IVANHOE ROAD · CLEVELAND 10, OHIO

BAILEY METER COMPANY LIMITED, MONTREAL, CANADA

Controls for Steam Plants

COMBUSTION · FEED WATER · TEMPERATURE

PRESSURE · LIQUID LEVEL · FEED PUMPS

Milwaukee, New Orleans, New York, Philadelphia, Pittsburgh, St. Louis, St. Paul, San Francisco, Schenectady, Seattle.

The Proof of the PRODUCT is in its Performance

The Very First RIC-WIL Prefabricated Insulated Pipe Units Ever Installed Are Still Giving Trouble-Free Service After 14 Years of Constant Use

Original condition of asphalt-coated conduit.

Asphalt-coated conduit still in perfect condition.

1949 • All lines functioning perfectly, trouble-free

MINNEAPOLIS "No trouble . . . in constant use"
OMAHA "In good condition and is still serving in its original capacity"
DES MOINES "No trouble . . . in first class shape"

In 1935 the first Ric-wiL Insulated Pipe Units using asphalt-coated Hel-cor conduit as the outer protective housing were installed for a large products pipe line company, at Minneapolis, Omaha and Des Moines. Each of these steam lines consisted of 3" pipe insulated and enclosed in 8" conduit of standard 21' length Ric-wiL Units, with return lines laid outside the conduit.

In 1941 a check-up on these Ric-wiL Units under actual service conditions was made. Parts of the runs were excavated and a careful examination made of the conduit, fittings, etc. The Ric-wiL Units were in practically perfect condition, the same as they were when installed, with no perceptible deterioration or other damage.

In 1949 a further check-up of all three installations was made. This investigation, as indicated by the quotations from the reports given above, showed all the lines still in constant use, functioning satisfactorily and trouble-free.

In the years since this original installation, in thousands of central heating and industrial processing projects, Ric-wiL Insulated Pipe Units, constantly improved by engineering research and development, **have continued to prove, through performance, their right to unchallenged leadership in this field.**

1. **HOUSING** of strong, shock-proof 16 gauge hot-dip galvanized Hel-cor conduit, spirally corrugated. Inside bonderized and coated with baked phenolic resin for additional protection.
2. **HIGH TEMPERATURE** asphalt coatings reinforced with tension wrapping of asphalt-saturated asbestos felt.
3. **INSULATION** of high thermal efficiency—any required type or thickness.
4. **PRESEAL RING** of steam-cured insulating cement protects units during shipping and installation.
5. **HEAVY IRON COLLAR** provides a firm foundation in making full-welded watertight field joints.

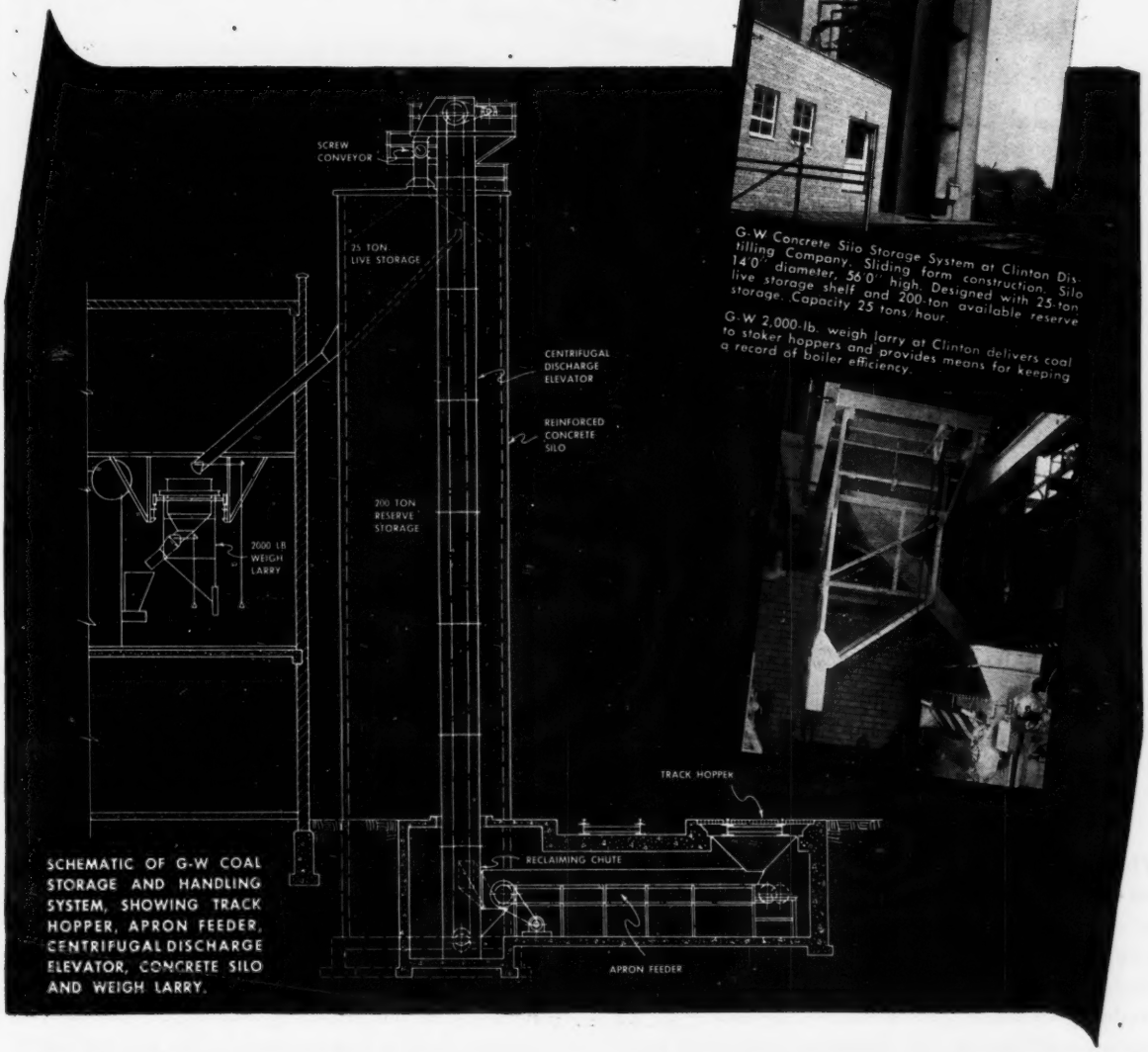
For complete information write for Ric-wiL Prefabricated Insulated Piping Systems Catalog 480-4. Address: The Ric-wiL Company, Dept. S-7.

RIC-WIL
INSULATED PIPING SYSTEMS
THE RIC-WIL COMPANY • CLEVELAND, OHIO
REPRESENTATIVES IN PRINCIPAL CITIES

Your Cost of HANDLING Coal Depends On How You STORE It

G-W Concrete Silo Storage System at Clinton Distilling Company. Sliding form construction. Silo 14'0" diameter, 56'0" high. Designed with 25-ton live storage shelf and 200-ton available reserve storage. Capacity 25 tons/hour.

G-W 2,000-lb. weigh larry at Clinton delivers coal to stoker hoppers and provides means for keeping a record of boiler efficiency.



SCHEMATIC OF G-W COAL STORAGE AND HANDLING SYSTEM, SHOWING TRACK HOPPER, APRON FEEDER, CENTRIFUGAL DISCHARGE ELEVATOR, CONCRETE SILO AND WEIGH LARRY.

The problems of automatic coal and ash handling in steam generating plants fall into the general design pattern of one of four basic types of G-W coal storage systems.

The system illustrated is an example of this kind of simplified engineering. Conditions at Clinton Distilling Co., Clinton, Iowa, called for the reinforced concrete type silo as best suited to their location, available space, and allowable initial cost per ton of storage. To complete the installation, G-W installed track hopper, apron feeder, centrifugal discharge elevator, and a 2,000-lb. weigh larry.

One of the four basic G-W Storage Systems with proper handling equipment, will be the right one for *your* plant conditions—Concrete Silo, Vitrified Tile Silo, Cylindrical Steel Tank, or Suspended Steel Bunker. Every complete G-W Coal and Ash Handling System is fabricated and installed under *one* contract, *one* responsibility, *one* delivery schedule.

Gifford-Wood's 135 years of materials handling experience is available without obligation to consultants, engineers and plant owners. If coal and ash handling is your problem, get in touch with G-W today.

3517

GIFFORD-WOOD CO.

SINCE 1814

G-W HANDLES IT faster • easier • cheaper

NEW YORK 17
420 LEXINGTON AVENUE

Factory:
Hudson, N. Y.

CHICAGO 6
565 W. WASHINGTON ST.

WHY MORE AND MORE PLANTS ARE CHOOSING SPREADER STOKERS

The current high price of coal places increased emphasis on the selection of a stoker that can burn a wide variety of coals efficiently . . . even the cheaper or lower grades. The spreader stoker is particularly well suited to meet these conditions. High ash, high volatile, eastern or mid-western bituminous, sub-bituminous, lignites — all are burned satisfactorily and efficiently by spreader firing. Coals with a high percentage of fines are no problem, for fines are burned in suspension and the larger particles on the grate. Thus, with the spreader stoker you are no longer limited to selected, premium-price coal and may take full advantage of the coals most economically available in your area.

C-E Spreader Stokers, available in both continuous discharge and dumping grate types, offer proven design features that make them outstanding values in their respective fields. And in addition, the users of the C-E Spreader Stoker gain the benefit of Combustion's vast knowledge of the proper application of fuel burning equipment — the accumulation of over 60 years experience in the design, manufacture and installation of more than 20,000 stokers under boilers of all types and sizes.

Moreover, since the C-E line includes every established type of stoker, Combustion is able to offer you impartial advice on the suitability of the spreader stoker for your plant. B-325

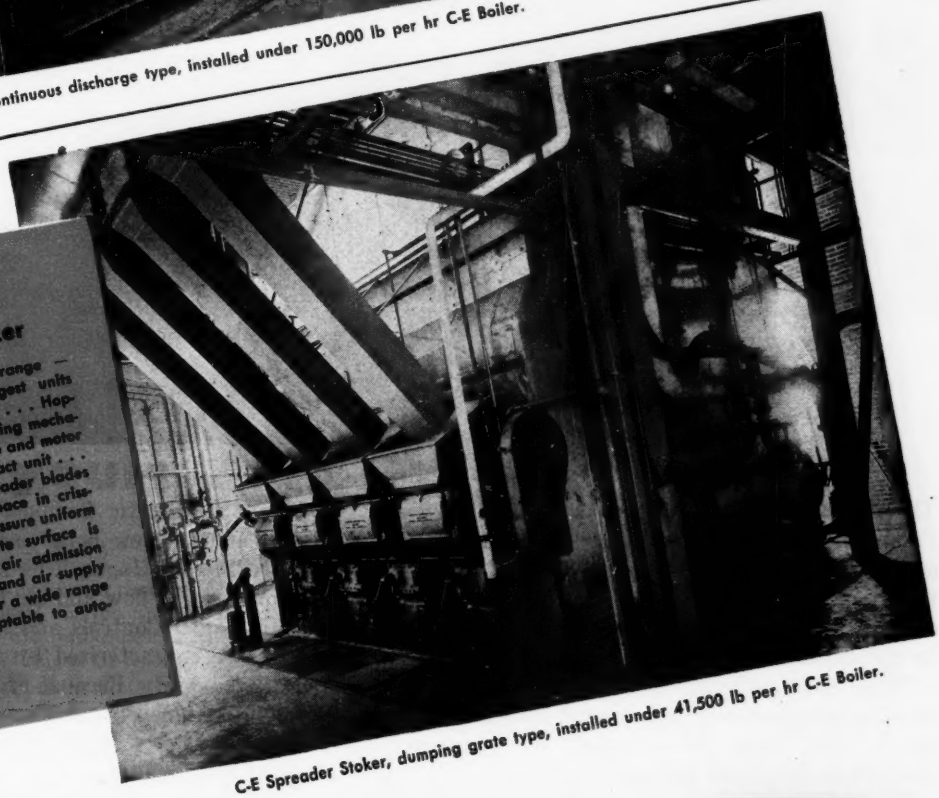
COMBUSTION ENGINEERING

A MERGER OF COMBUSTION ENGINEERING COMPANY, INC. AND THE SUPERHEATER COMPANY

The C-E Spreader Stoker Pays for Itself Over and Over

In an average installation the cost of coal used in a year exceeds many times the initial cost of a C-E Spreader Stoker. Moreover, its first cost is soon absorbed by its saving in coal cost—an economy cycle repeated throughout its many useful years of life.

C-E Spreader Stoker, continuous discharge type, installed under 150,000 lb per hr C-E Boiler.



Features of the C-E Spreader Stoker

Approximate application range — from 150 hp to the largest units adaptable to stoker firing . . . Hopper, feeding and distributing mechanism, variable-speed drive and motor are combined in a compact unit . . . A series of rotating spreader blades feeds coal into the furnace in crisscrossing streams which assure uniform distribution . . . Grate surface is zoned for regulating air admission . . . Rate of fuel feed and air supply may be regulated over a wide range and are readily adaptable to automatic control.

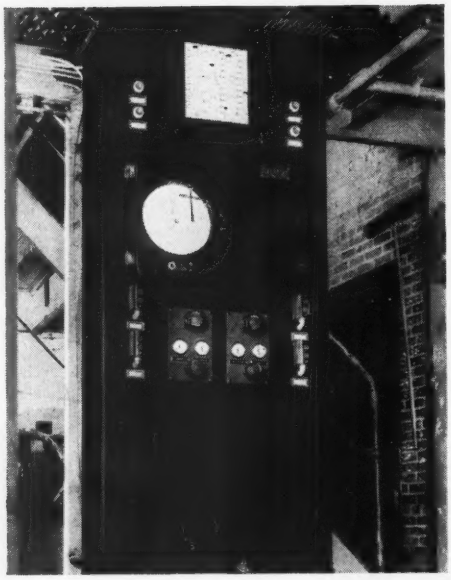
C-E Spreader Stoker, dumping grate type, installed under 41,500 lb per hr C-E Boiler.

—SUPERHEATER, INC.

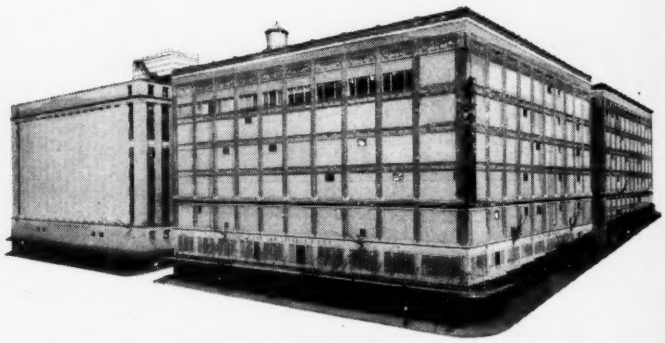
200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

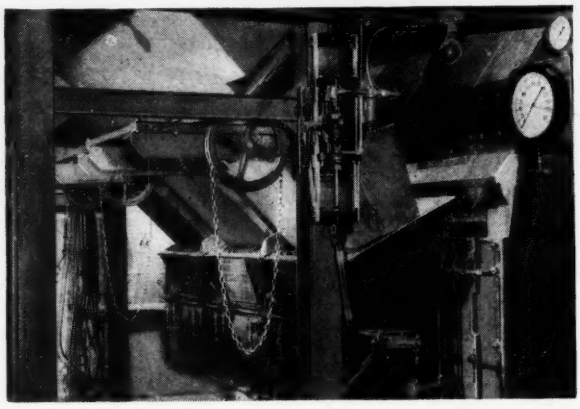
FIRST, HAGAN CONTROLS,
then HAGAN controls and meters . . .
AT F. & R. LAZARUS & COMPANY



Control panel of the new boiler at F. & R. Lazarus & Company, Columbus, Ohio, showing Hagan Ring Balance Boiler Meter.



The main buildings of F. & R. Lazarus Company occupy a full city block. Steam is used primarily for heating, but some is required for laundry and cooking.



View of front boiler. Hagan fuel control cylinder is shown in foreground. Boiler was installed by the manufacturer, Combustion Engineering Corporation. Edward E. Ashley of New York was consulting engineer.

The store of F. & R. Lazarus & Company in Columbus, Ohio—now managed by the fourth generation of the Lazarus family—would do credit to any city. Its main buildings now occupy a full city block, and additional buildings are used for special departments and services.

These main buildings represent an almost constant program of construction and modernization, which has been accompanied by necessary changes in the steam generating plant.

Hagan Control—a master sender, compensating relay, receiving regulators and balanced float controllers—was installed on two boilers in 1944.

Continued expansion of the store made further modernization of the boiler plant necessary, and in 1949 a new boiler was installed. This is stoker fired, has a capacity of 31,500 lb./ hr. and operates at a pressure of 125 psi.

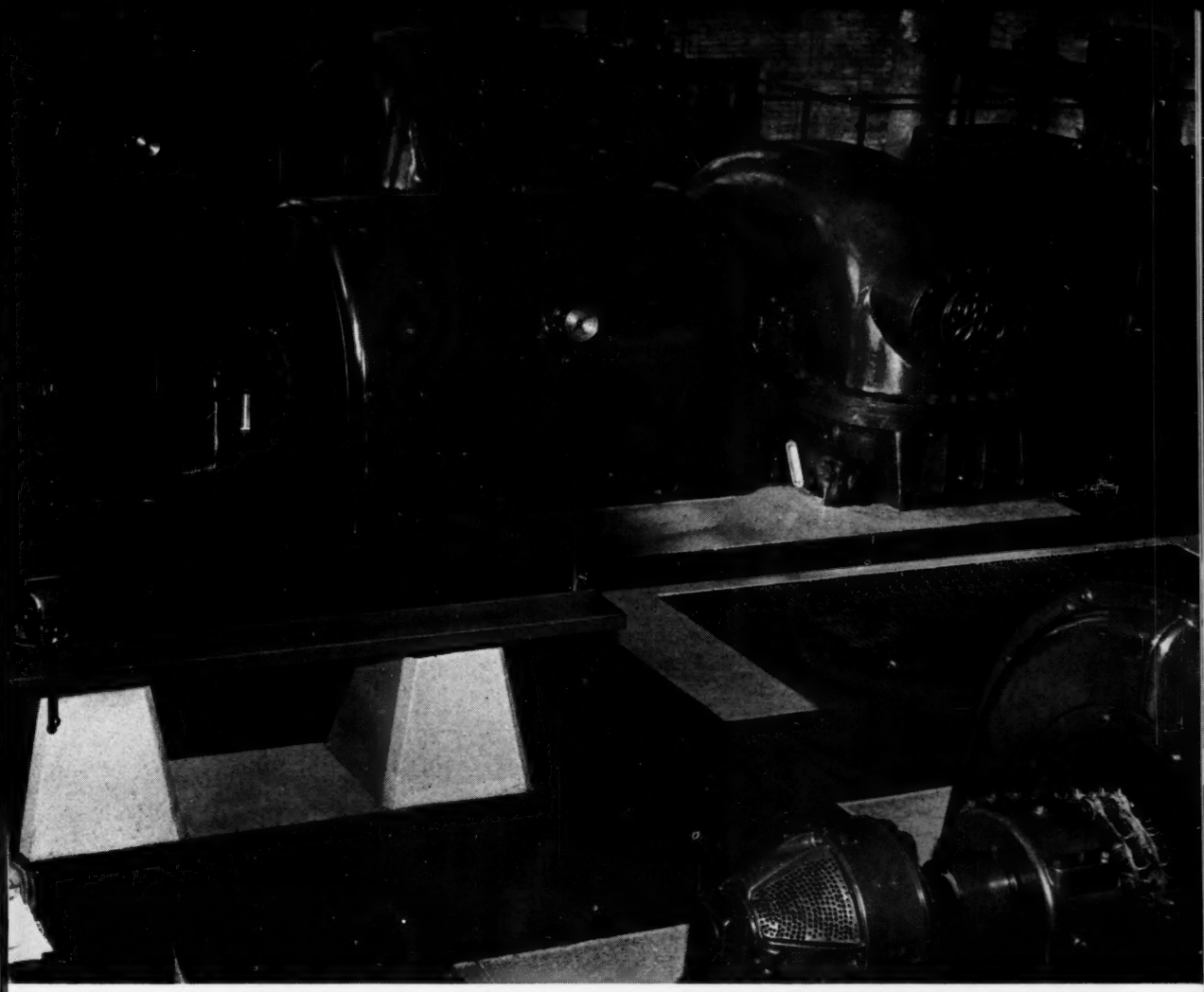
Hagan Automatic Combustion Control was installed on this new boiler, and a separate panel was provided. A Hagan Ring Balance Boiler Meter measures steam flow and air flow.

Both Hagan Controls and Hagan Ring Balance Meters are characterized by simplicity, accuracy and dependability. Because of these qualities they are giving eminently satisfactory service in steam generating plants of all types and sizes, in all parts of the country.

For full information on either meters or controls, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

HAGAN CORPORATION

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES



These turbine lubrication savings can be yours . . .

Simply by your choice of turbine oil, you can eliminate the cost, the time and the labor of replacing turbine oil. You can eliminate also the need for removing turbine oil for treating and the need for cleaning oil systems. Evidence that you can make these savings is supplied by S. H. Smith, superintendent of the Board of Public Works, South Haven, Michigan. He reports:

"When the first of our three present turbines was installed in 1936, we filled it with Nonpareil Turbine Oil. This practice was followed with each of the other two turbines. *In 13 years' use of Nonpareil, we have had no shutdowns resulting from dirty oil or from the necessity of replacing oil.* It has not been necessary to clean the oil. Semi-annual tests have shown that the oil has not deteriorated in any way."

Your switch to Nonpareil Turbine Oil will insure safe and economical lubrication, not only for 13 years, but for the *life* of your turbines. You receive with each fill of Nonpareil a written guarantee that the oil will last as long as the turbine and that its acidity will stay below a neutralization number of 0.15 mg. KOH/gm. Find out from a Standard Oil Lubrication Engineer how Nonpareil has lived up to its guarantee, how it has reduced utility lubrication costs as much as 68%.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

NONPAREIL
Turbine Oil

"WILL OUTLAST YOUR TURBINE"

TANDARD OIL COMPANY (INDIANA) STANDARD

2,800,000 Lb Per Hr of Controlled Superheated Steam

Produced in One Station by Foster Wheeler Twin Furnace Steam Generators

Slag-free Operation

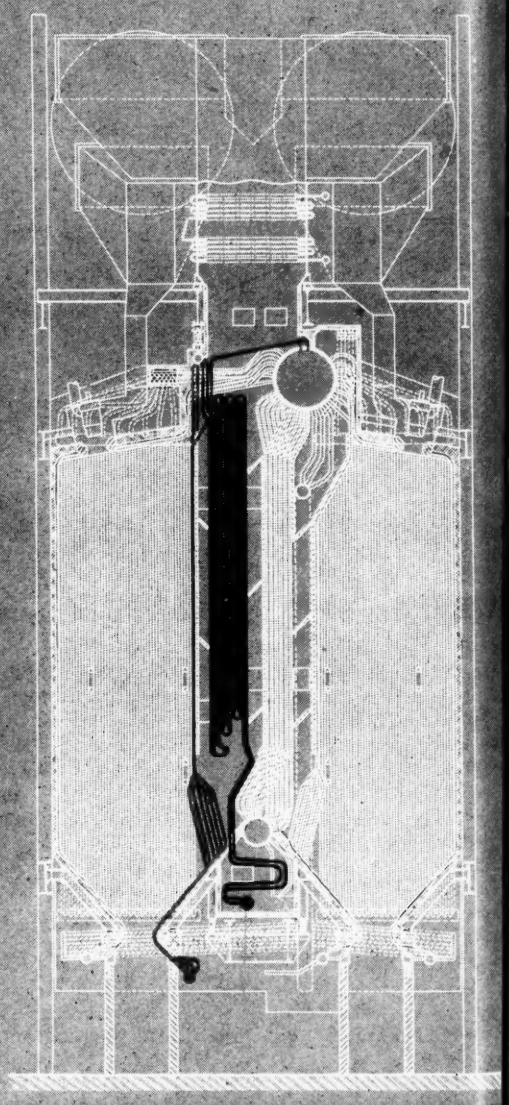
Furnace exit gas temperatures of high capacity, high pressure, high steam temperature units are established by the slagging characteristics of the fuel fired. The Twin Furnace design provides approximately 30% more cooling surface than a single furnace unit having similar furnace proportions.

Controlled Final Steam Temperature

By judicious proportioning of the surface of the radiant superheater located in one furnace and the convection superheater, a desirable flat characteristic steam temperature curve may be attained. Further control is obtainable by differentially firing the two furnaces thus stabilizing steam conditions for optimum turbine efficiency over the widest possible operating range.

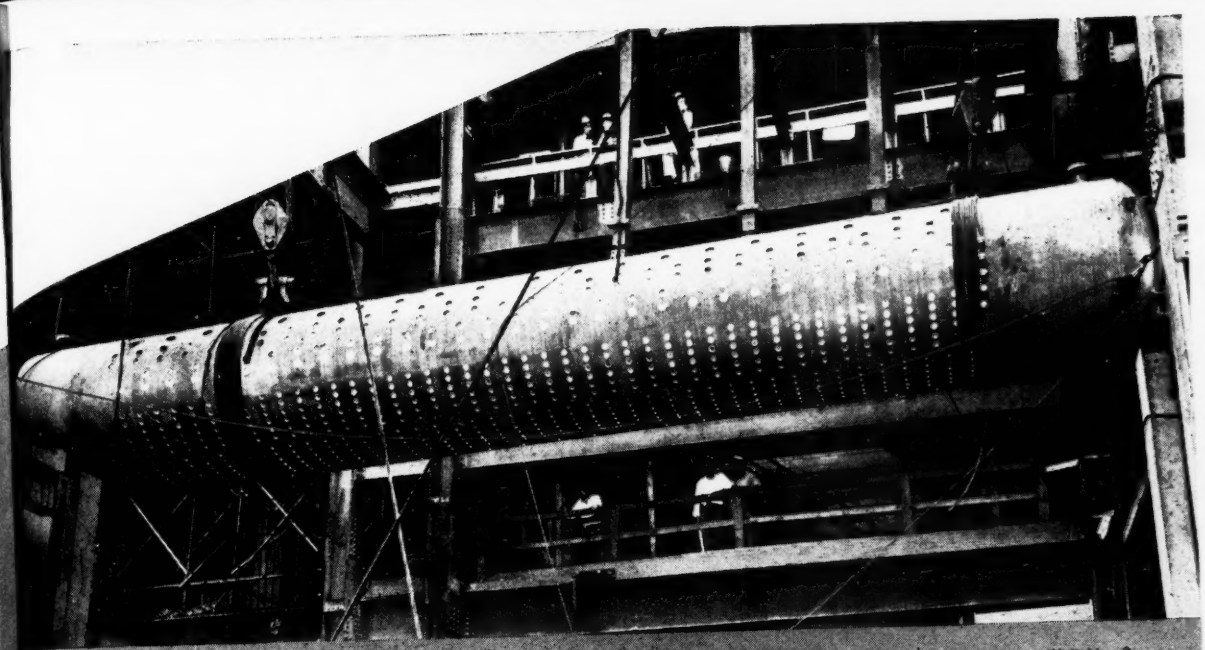
Compact Design

Substantial saving in building space is achieved through the use of smaller permissible furnace volumes with increased cooled wall area distributed in two furnaces and by compact arrangement of all component parts of the unit.

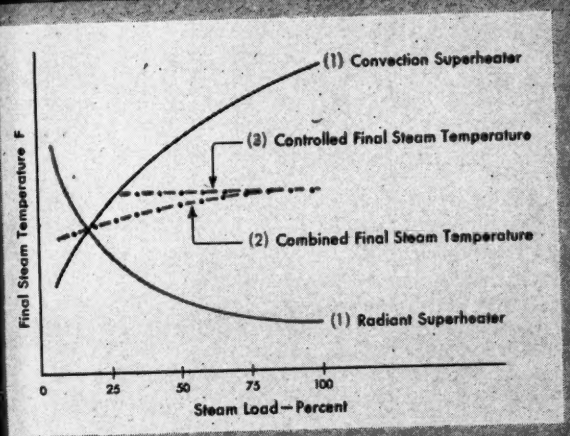


Duquesne Light Company
Phillips Power Station
Pittsburgh, Pennsylvania

Steam capacity	600,000 lb per hr
Superheat control range	270,000 to 600,000 lb per hr
Pressure superheater outlet	900 psi
Final steam temperature	900 F
Bituminous Coal Pulverized in FW Ball Mills	



An upper steam drum being placed in position at Unit No. 2 of the Phillips Power Station of the Duquesne Light Company.



Curves showing final steam temperature

(1) Convection and radiant superheaters operating independently

(2) Twin Furnace combination radiant and convection superheater

(3) Controlled differential firing at lower partial loads, minimizing the need for special temperature control equipment.

A total of 5 Twin Furnace steam generators—designed, engineered, and constructed by Foster Wheeler—will be installed at the Phillips Power Station of the Duquesne Light Company which serves a large area in and around Pittsburgh, Pa. Two are already in service and three are on the way. This station, which will generate 237,000 kilowatts when completed, is part of a system covering a territory populated by some 1,500,000 persons.

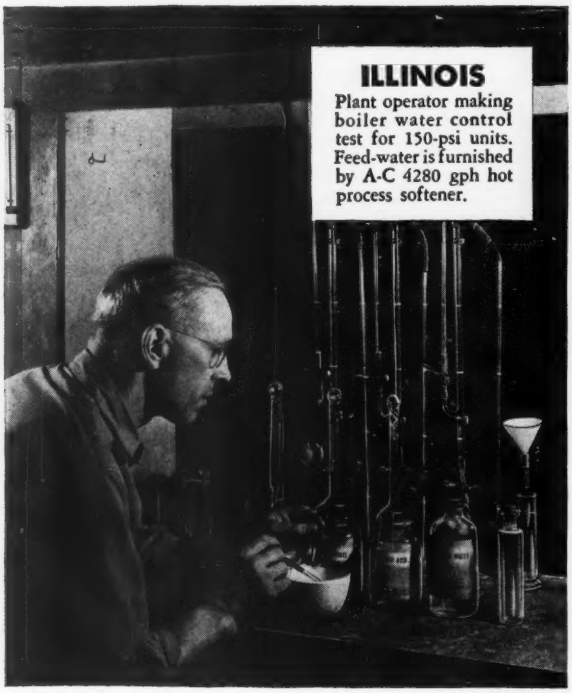
Growing preference for this ideally balanced design is evidenced by the fact that other large utilities are now using Foster Wheeler Twin Furnace steam generators. The Twin Furnace arrangement with combination radiant and convection superheater permits constant final steam temperature through exceptionally wide load ranges.

FOSTER WHEELER CORPORATION 165 BROADWAY, NEW YORK 6, N. Y.

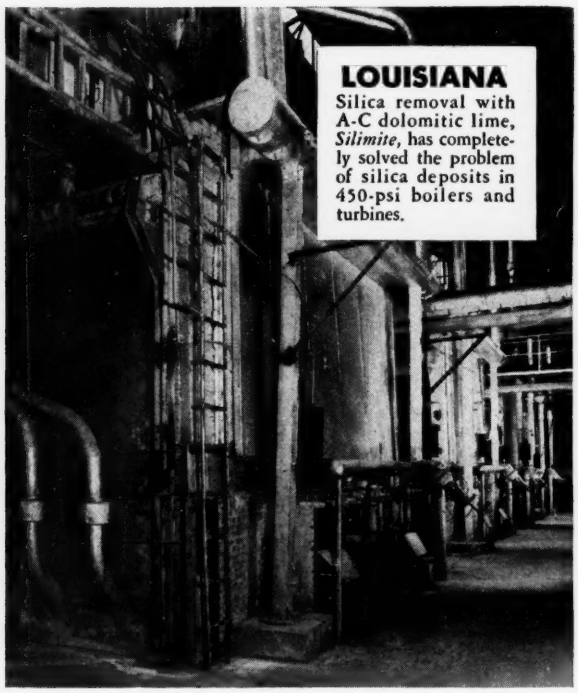
FOSTER WHEELER

37 Paper Mills

with Allis-Chalmers Water Conditioning



ILLINOIS
Plant operator making boiler water control test for 150-psi units. Feed-water is furnished by A-C 4280 gph hot process softener.



LOUISIANA
Silica removal with A-C dolomitic lime, *Silimite*, has completely solved the problem of silica deposits in 450-psi boilers and turbines.

EXPERIENCE OF PAPER MILLS ACROSS U. S. IS TYPICAL OF ALLIS-CHALMERS AID TO ALL INDUSTRIES FACING WATER PROBLEMS IN STEAM OR POWER GENERATION

WHEREVER WATER IS HARD, high in silica, or contains objectionable material, Allis-Chalmers provides proper treatment to avoid costly damage to boilers, superheaters, turbines and process equipment. That's why these and many other paper mills are finding A-C's 3-way program of Service, Chemicals and Equipment their best means of solving water conditioning problems.

Save Time Trouble, Money, with 3-Way Program!

1. SERVICE

Prompt, regular, personal service calls are the backbone of the A-C program! 1) Survey of plant, securing samples of water from all parts of system. 2) Complete analysis by A-C research lab to provide bases for recommendations. 3) Subsequent checks on procedure, control limits, feeding of chemicals, and factors affecting plant operation.

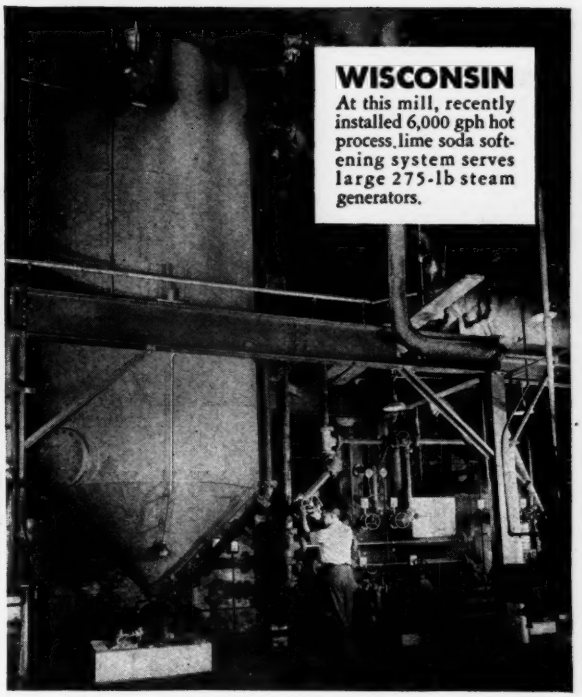
2. CHEMICALS

Properly selected chemicals, correctly applied, assure peak efficiency. A-C engineers give you sound advice on where and how these chemicals can be best used. Formulations include scale inhibitors for all heat exchange cycles . . . special chemicals to prevent boiler scale, control corrosion, reduce silica, and correctly condition sludge.

Get Top Results

Service, Chemicals, Equipment

MICHIGAN
This mill features a newly installed 343,-000 gal sodium-hydro-gen zeolitecombination for feeding 415-psi boilers.



WISCONSIN
At this mill, recently installed 6,000 gph hot process lime soda soft-ening system serves large 275-lb steam generators.

Whatever the industry — paper, petroleum, food, steel — you'll get prompt, convincing results with Allis-Chalmers competent service. Remember, your A-C engineer is prepared to share his experience with you by recommending proper chemicals or helping select the right process for your requirements on the basis of space, cost, and character of raw water. For further information, call your nearest Allis-Chalmers office or write direct.

Silimite is an Allis-Chalmers trademark.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

3. EQUIPMENT

Correct selection of equipment calls for judgment based on experience. From chemical feeder to filter, A-C units are engineered for high treating capacity, built solidly for best operation. Secure your equipment from A-C's line of hot and cold process softeners, sodium and hydrogen zeolites, deionizers, chemical proportioners, filtration systems.

WATER TREATMENT PROBLEM? SEND COUPON TODAY

ALLIS-CHALMERS, 953A SO. 70 ST.
MILWAUKEE, WIS.

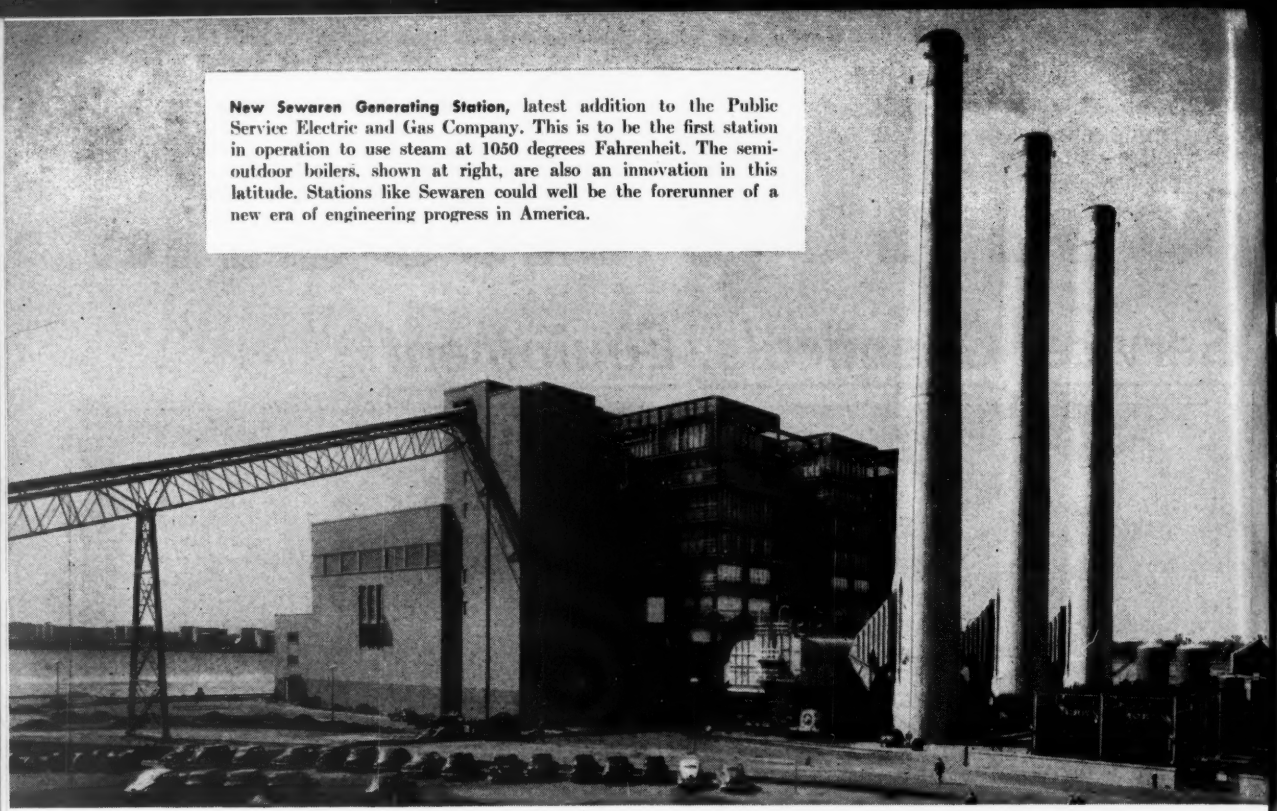
Please send me bulletins:
- ☐ 28X6385A Chemicals and Equipment
- ☐ 28B6611 Hot Process Softeners
- ☐ 28B7107 Sodium Zeolite Softeners

Name..... Company.....

Position..... Address.....

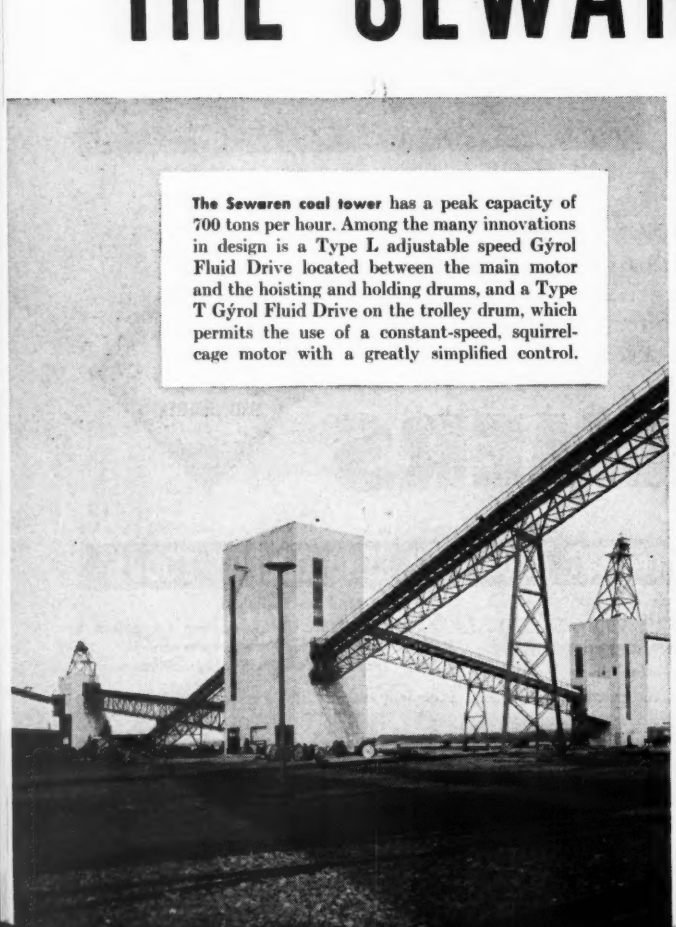
City..... State.....

A-2756

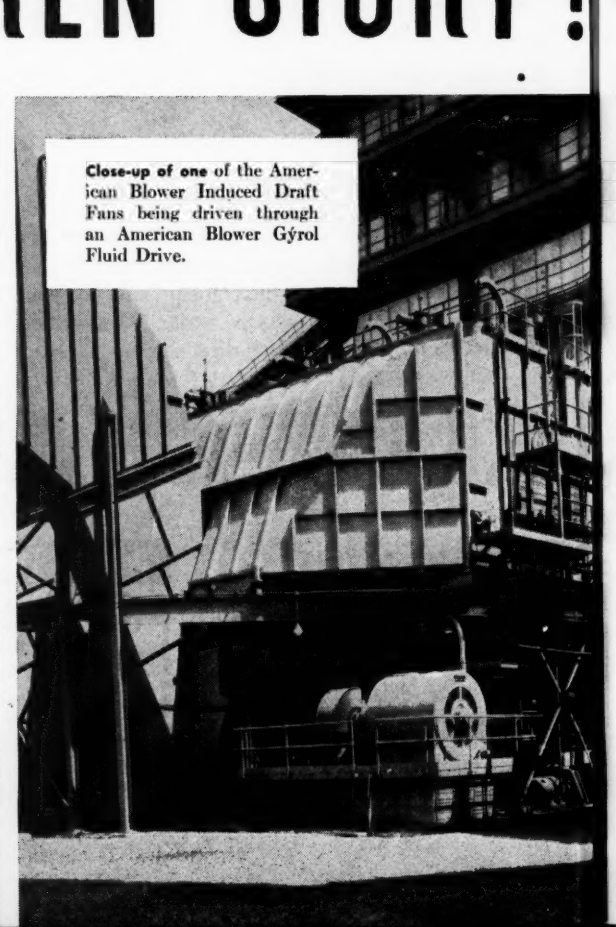


New Sewaren Generating Station, latest addition to the Public Service Electric and Gas Company. This is to be the first station in operation to use steam at 1050 degrees Fahrenheit. The semi-outdoor boilers, shown at right, are also an innovation in this latitude. Stations like Sewaren could well be the forerunner of a new era of engineering progress in America.

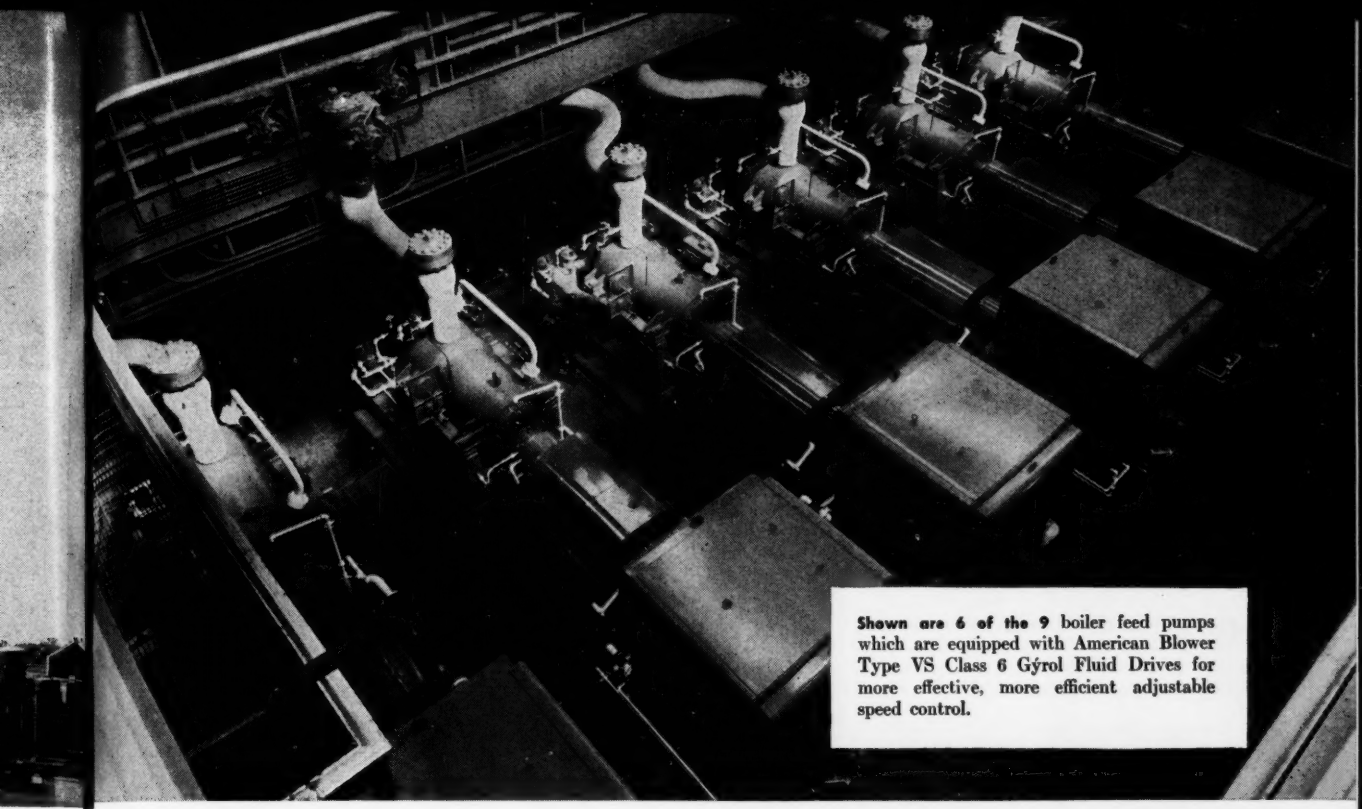
THE SEWAREN STORY!



The Sewaren coal tower has a peak capacity of 700 tons per hour. Among the many innovations in design is a Type L adjustable speed Gýrol Fluid Drive located between the main motor and the hoisting and holding drums, and a Type T Gýrol Fluid Drive on the trolley drum, which permits the use of a constant-speed, squirrel-cage motor with a greatly simplified control.



Close-up of one of the American Blower Induced Draft Fans being driven through an American Blower Gýrol Fluid Drive.



Shown are 6 of the 9 boiler feed pumps which are equipped with American Blower Type VS Class 6 Gýrol Fluid Drives for more effective, more efficient adjustable speed control.

New modern generating station marks another milestone of progress in the American way of life—brings compliments from many quarters to Public Service Electric and Gas Company for farsightedness and progressive spirit.

AMERICA in general, and New Jersey in particular, can look forward to great progress as forecast by the formal opening of the new Sewaren Generating Station at Sewaren, New Jersey.

Full of advanced engineering ideas and techniques, embodying the most modern facilities known to man, designed with the future in mind, this new project, for years to come, insures the area it serves an abundant supply of electricity—the life-blood of American progress.

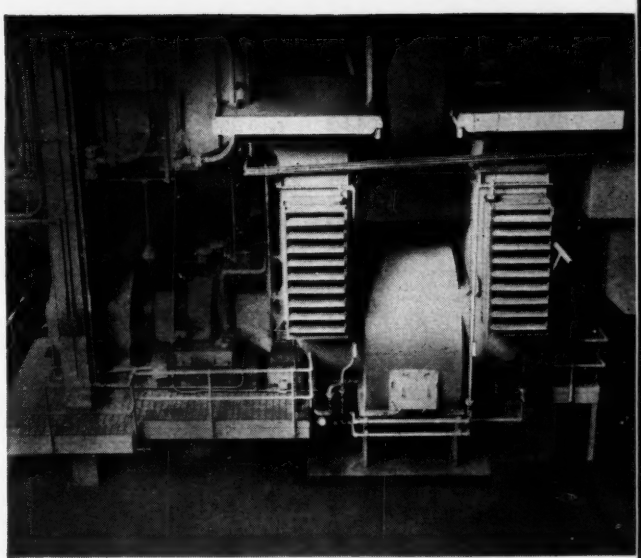
Long-range planning, like that exemplified in the Sewaren Station, has always paid off in America. It always will.

That we of American Blower were privileged to play a part in making the Sewaren Generating Station a reality, marks a milestone in our own progress upon which we shall always look with pardonable pride.

American Blower furnished for this new modern plant 6 Sirocco Induced Draft Fans, each handling a total of 227,000 cubic feet of gas per minute, at 18.6 inches static pressure, 2 of which are equipped with 1250 h.p. at 570 rpm, adjustable speed Gýrol Fluid Drives; 6 American HS Forced Draft Fans, each having a capacity of 123,000 cubic feet of air per minute, at 22 inches static pressure, and each fan driven through a 600 h.p. at 1135 rpm, adjustable speed Gýrol Fluid Drive; 9 Gýrol Fluid Drives, each having a capacity of 2000 h.p. at 3465 rpm, for adjustable speed control of boiler feed pumps.

What about your plans? If you intend to modernize or enlarge your facilities, we invite you to contact the nearest American Blower Branch Office. You'll find it staffed with experienced engineers who know the meaning of cooperation and service.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION



This close-up shows one of six American Blower Forced Draft Fans being driven through an American Blower adjustable speed Gýrol Fluid Drive.

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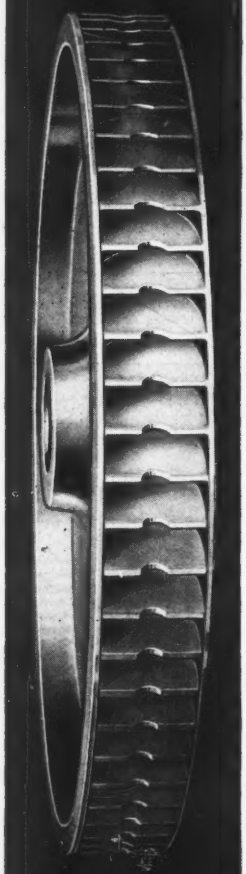
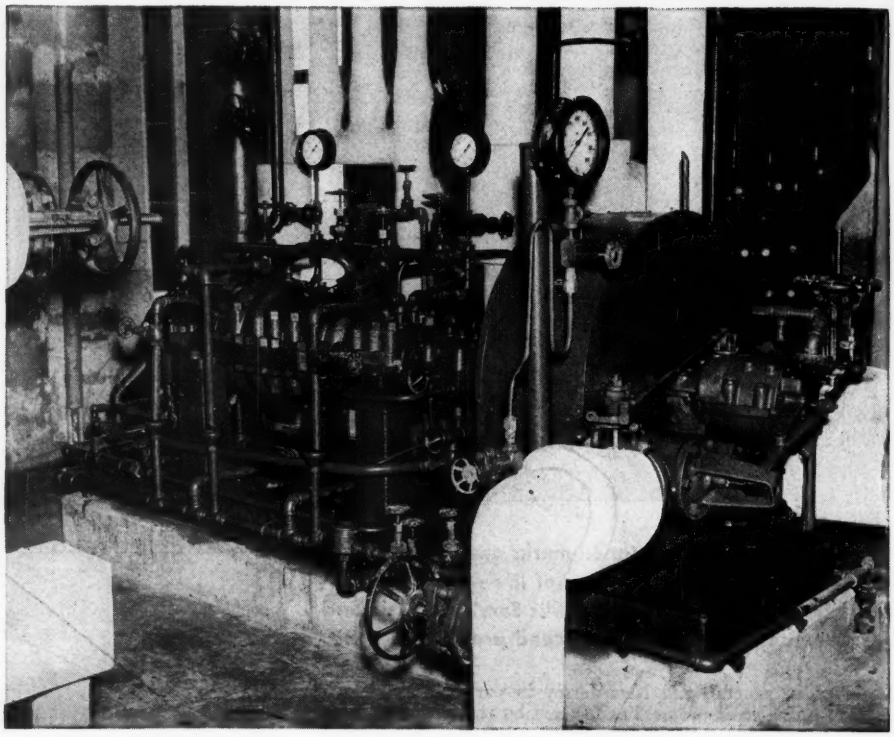
TERRY





Large Turbine Clearances for DEPENDABILITY *In Desuperheat Control*

In the design of this topping plant emphasis was placed on dependability and continuity of service.

An important feature is pressure reducing and desuperheating 1250 psi, 900 F steam to 400 psi, 600 F, at various rates to meet low-pressure steam and power demands.

For this service the 100 hp Terry Solid-Wheel Turbine, shown above driving a desuperheating water pump, is ideal. It has large radial and axial clearances and protective rims at the sides of the wheel. The blades cannot foul, end play can do no damage.

A descriptive bulletin on this dependable turbine will be sent upon request.

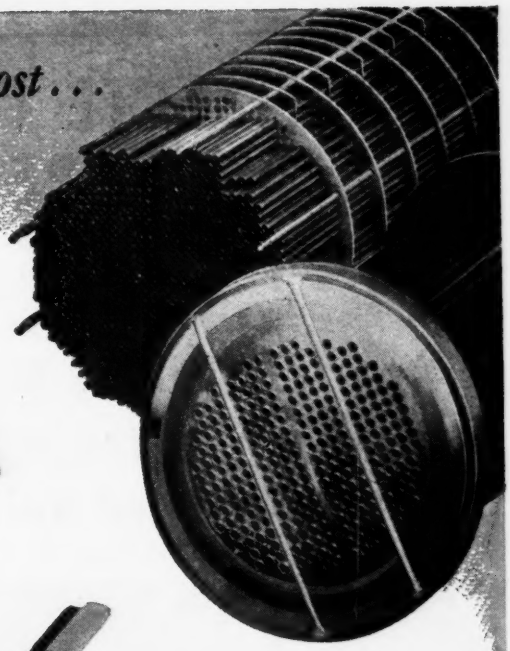
T-1180

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

For long service at lowest cost . . .

B&W

CARBON, ALLOY, AND STAINLESS STEEL



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- . . ease of fabrication and installation
- . . service-proved quality and dependability

Because B&W Condenser Tubes are:

. . Available in *seamless* and *welded* types, and a full range of carbon, alloy and stainless grades.

. . Made to your specifications.

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THE BABCOCK & WILCOX TUBE COMPANY
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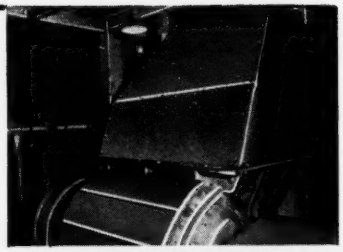
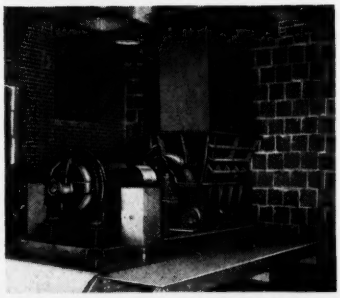
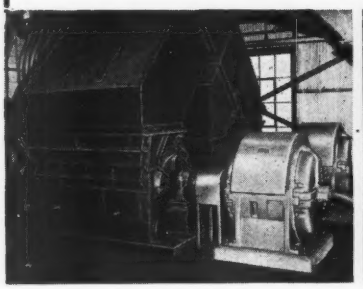
TA-1444-O

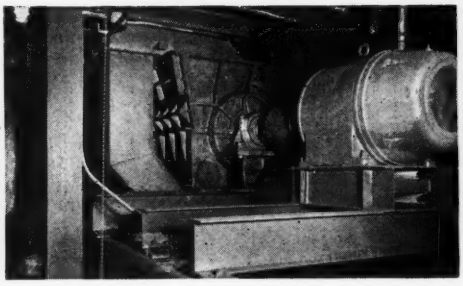
A COMPLETE COAL CRUSHING OPERATION in less than 12' x 12' x 12'

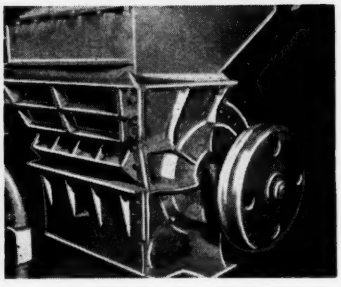
American Rolling Ring Crushers provide high tonnage reduction with controlled uniform sizing



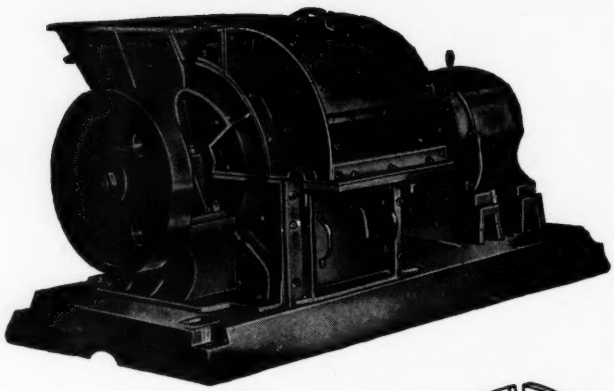








Americans are contributing to greater firing efficiency in power plants everywhere. ROM coal is rapidly reduced to stoker or pulverizing sizes in one low-cost operaton. A complete, compact crushing operation requiring only minimum headroom and no auxiliary crushing or breaking units. Americans incur little or no extensive plant alterations. American Rolling Ring Crushers are built in capacities up to 500 TPH.



Only Americans offer the patented shredder ring action that *splits coal* by efficient cleavage action of multiple cutting edges.

Get the data on improved coal preparation— Send for Americans "S" Crusher Bulletin.

American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

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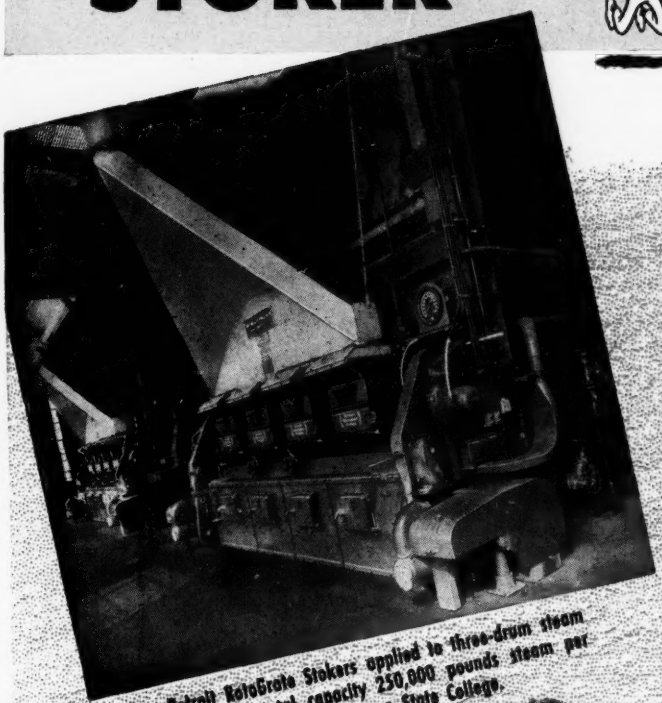
See DETROIT ROTOGRATE STOKER

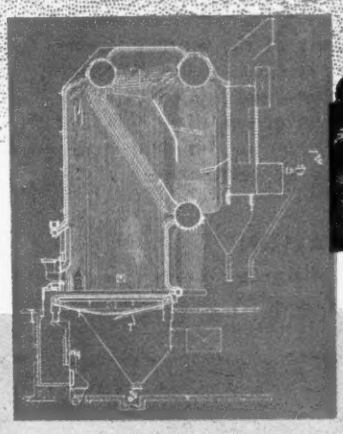


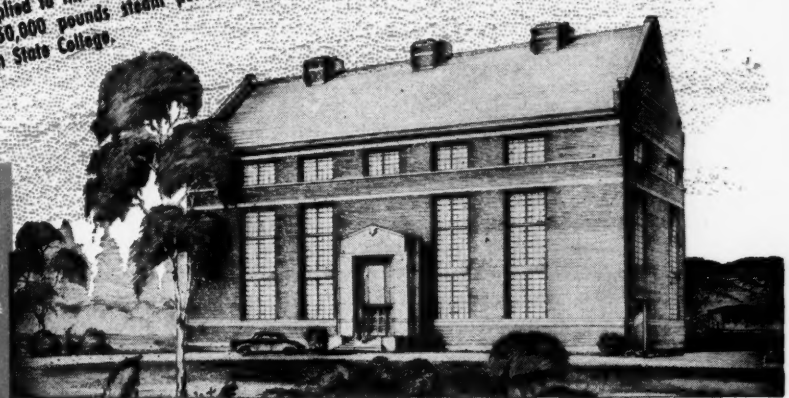
Detroit RotoGrate Stokers applied to three-drum steam generators, total capacity 250,000 pounds steam per hour at Michigan State College.

The selection of Detroit RotoGrate Stokers for Michigan State's New Power Plant is typical of the trend of the times. It is only one of several Michigan institutions for which Detroit RotoGrate Stokers have been selected in a current modernization program.

RotoGrates have established a reputation during the past ten years for producing high efficiency with a wide range of fuels.

WRITE for Bulletin





New Modern Power Plant—Michigan State College, East Lansing, Mich.
Claud R. Erickson, Cons. Engr., Lansing, Mich.

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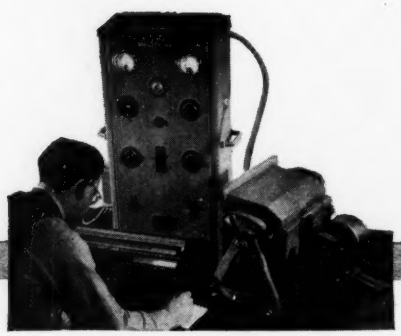

X-Ray equipment, used in the Nalco Laboratories as an aid toward providing positive water treatment results.

● *Water treatment service for small plants is an important part of Nalco's business.*

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Small plants find Nalco Service Agreements a profitable investment . . . And

Nalco facilities and services are geared to handle — efficiently and economically — the needs of *any* plant, regardless of its size or the volume of water treatment chemicals used.

If your plant is a small one, you can get the same security from water treatment difficulties as many of the world's largest steam generating stations have with Nalco Service Agreements — and at a cost entirely in line with the size of *your* plant and your problems. Write today for complete details, or call your Nalco Representative.

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HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail

ELECTRICAL

101 **Motor Protection**—Bulletin 51B6210B, 8 pp, describes the design and construction features of manufacturer's "safety circle" motor that add up to long life and low operating costs. According to the bulletin, these drip-proof and splash-proof motors are available in sizes from 1 hp at 1800 rpm to 20 hp at 3600 rpm, in frames 326 and smaller, and the same design advantages and protection are available in totally enclosed types. Allis-Chalmers Mfg. Co.

102 **Induction Motors**—Synchronizer 28, 32 pp, covers in four parts the basic theory, operation, characteristics and applications, and control of large induction motors. It presents a comprehensive practical, fact-filled treatment of squirrel-cage and wound rotor motors. Lavishly illustrated with photographs and cutaway views and has nearly 50 graphs with explanatory figures to accompany the text. Electric Machinery Mfg. Co.

103 **Wire for Hot Spots**—Catalog 509, 34 pp, covers a line of wires and cables having asbestos or asbestos and varnished-cambric insulation, suitable for electrical installations where extreme heat, corrosive fumes and fire hazards are present. Equipment described includes 600-v cable for motor connections and electric furnace leads, control cable for boiler rooms and power stations, cable for hinge or jumper connections on swinging panels, and high voltage power cables. Catalog describes and illustrates a line of 300-v cable for arc lamps and spot lights, stove wire, heat-resisting flexible cord and fixture wire, as well as 600-v switchboard wire. Specifications, sizes, weights given. National Electric Products Corp.

104 **Selenium Rectifier Stacks**—Six pp Brochure C-349-848 features a line of selenium rectifiers for a-c to d-c conversion. Contains operating characteristics, applications, circuit diagrams and design data and price information on full wave, single phase and bridge rectifiers. Also features cross sectional view of a typical selenium rectifier stack and a description of a 6¼ by 7¼ in. selenium rectifier cell, said to be the largest comercially available in this country. Also covers manufacturer's standard line of rectifier cells. International Rectifier Corp.

105 **Manual Starters**—Four-pp Circular TEC-317A describes and illustrates a thermostatic tumbler manual starter which provides overload protection for small motors up to 1 hp, emphasizing its heater. Circular contains many photos of starters and component parts, and recommends applications. Also includes dimensional data and suggested specifications for users. The Trumbull Electric Mfg. Co.

106 **Oil Circuit Breakers**—Bulletin 71B-6129D, 4 pp, describes oil circuit breakers for central station and industrial service where economy of operation and space are important factors. Photos of typical contact assemblies, tanks, and a cross section sketch of ruptor interrupting device are accompanied by a discussion of the construction features and operation of these circuit breakers. Includes table of ratings and reference chart of general dimensions. Allis-Chalmers Mfg. Co.

107 **Metal for Contacts**—Technical Data Bulletin 7.101 covers the use of Fastells for heavy duty contacts. Discusses the general characteristics of the Fastells, which are described as "new metals found in nature, not alloys and not bonded, but unified through metallurgy." Explains how these materials are made from metal powder under heavy pressure then sintered in controlled atmosphere. Gives physical properties of both silver and copper Fastells and explains mechanical and electrical design features of contacts made from them which contribute to improved performance. Fansteel Metallurgical Corp.

PIPING AND VALVES

108 **Twin Strainers**—Bulletin A-13, 12 pp, describes two basic types of twin strainers for continuous service in clearing liquids, featuring the new of these types. Explains and illustrates, by photos, the component parts of these strainers and provides maintenance tips. Includes specifications, dimensional data, graph showing pressure drop. Elliott Co.

109 **Refrigerant Service Hose**—A charging hose of a new type of construction is described in pocket-size Folder CMH100. This construction is illustrated in detail and its special features told. Sizes and prices of this hose are included. Chicago Metal Hose Corp.

110 **Regulating Valves**—Bulletin 47-1, 23 pp, is intended to acquaint power engineers with the merits of a valve design widely useful in many industries. The operating principle of these single seat pilot balanced regulating valves is described fully and illustrated with schematic drawings and dimension charts. Contains information on the slip-stem and rotary shaft types for steam, air and gas, and the slip-stem and rotary shaft types for liquids. Includes circumferences and areas of circles and flange dimension charts. Belfield Valve Div., Minneapolis-Honeywell Regulator Co.

111 **Diaphragm Control Valves**—Bulletin 700-1, 31 pp, offers descriptions and drawings of a diaphragm motor controlled valve with radiation fins and positioner, direct acting and reverse acting diaphragm motor controlled valve with manual operator, pilot-operated valve, venturi throat valve, three-way, duplex and single-seated valves. Also includes dimension tables and ratings, shipping weights and cubical measurements. A section is devoted to pilot piston control valves, providing flow charts, sizes and dimensions. Belfield Valve Div., Minneapolis-Honeywell Regulator Co.

112 **Unions and Fittings**—Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special construction features and other advantages. Also illustrates all equipment offered, along with sizes and materials available. Catalog is accompanied by current price list. E. M. Dart Mfg. Co.

113 **Gas Combustion Equipment**—Condensed Catalog ID-292, 12 pp, describes and pictures 33 items of gas combustion equipment. Capacity and dimensional tables are included for combustion assemblies, gas-air and air-gas mixers, blowers and boosters, many types of burners, pilot and ignition devices, controls, valves, regulators and other accessories. Bryant Industrial Div., Affiliated Gas Equipment, Inc.

114 **Water Tube Boilers**—This 12-pp bulletin illustrates and describes special and standard power plant boilers and packaged steam generators. Includes data and dimensions. Springfield Boiler Co.

115 **Boiler Seam Protection**—This 6 pp, pocket-size folder illustrates and describes manufacturer's seam protector which is installed to insulate riveted seams on HRT boilers, in which the arch of the refractory tile protects the seam from fire-cracking and leaking. National Boiler Protector Co.

116 **Spreader Stoker Selection**—Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to

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be considered in the selection. It pictures and describes in detail the principle operating parts of manufacturer's stokers, emphasizing their advantages. Includes engineering drawings and photos of several typical installations. American Engineering Co.

117 **For Better Coal**—Bulletin 449, 4 pp, is intended for coal men in the interest of producing better coal—but it's informative reading for power engineers, as users of coal. Titled, "Who Pays the Freight?" it shows how a modern coal preparation plant can produce coal, or "solidified heat," that is free of extraneous matter and freeze-proof, eliminating the necessity of paying freight on water and non-heat producing wastes. Booklet states that better coal is the answer to competition from other fuels. Geo. P. Reintjes Co.

INSTRUMENTS AND CONTROLS

118 **Electronic Gages**—A remote reading liquid level gage is featured in this 8-pp bulletin. It discusses in detail the receivers, transmitters and wiring used for installation in hazardous and non-hazardous loactions. Stresses the economy, accuracy, versatility and safety of installation of the gages. Includes diagrams for installations serving up to 10 tanks and for installations serving up to 24 tanks. The Vapor Recovery Systems Co.

119 **Gage Testers**—This 4-pp brochure describes and illustrates a dead weight gage tester, giving construction details and operating instructions for a high pressure, low pressure and double range model. Table shows standard weight groups furnished with these testers. Star Brass Mfg. Co. Div., Williams & Hussey Machine Co., Inc.

120 **Absolute Pressure Gages**—Bulletin G620, 6 pp, introduces a new series of absolute pressure gages for chart record, automatic control or remote measurement. Illustrated with photos of instrument, a typical chart record, and schematic diagrams showing principle of operation. Text covers construction details, accuracy, chart ranges and applications. Dimensions included. The Bristol Co.

121 **pH Instrumentation**—In its 16 pp of text and pictures, Bulletin 430 covers briefly the connection between pH and plant efficiency; electrometric measurement and its applications, and the recording and controlling instruments designed to handle the work. Illustrates and describes instruments, giving their applications and ranges, also covers electrode assemblies and accessories. Includes mounting dimensions. The Foxboro Co.

122 **Pocket Size Ammeter**—A split core volt ammeter designed to measure current without interrupting service is featured in Catalog 109, 4 pp. Photos show actual size of the small, lightweight instrument and sketches illustrate its many advantages. Complete dimensions and specifications given, also typical scale ranges illustrated. Pyramid Instrument Co.

123 **Metering Chlorine**—Bulletin 840-F2 describes an instrument designed to accurately meter chlorine gas and deliver a chlorine water solution to the point of application. Discusses the safety and other features of the instrument and explains its operation and maintenance. Illustrations include photos, a phantom drawing showing principle working parts, and a layout diagram. Builders-Providence, Inc.

124 **Air Meter**—Bulletin 25A, 4 pp, explains the operation and application of a new air meter. Amply illustrated with photographs, the folder shows how the instrument is used to measure air velocity from 10 fpm to 6000 fpm, in increments as small as 2½ fpm. Also explained is the application to temperature measurements ranging from 30 to 155 F, within accuracy limits of 1/3 of a degree. Also covers static pressure work, in which case, values are read directly in terms of inches of water. Here, the range is from 0 to 4 negative and 0 to 10 positive with accuracy of 0.05 at lowest levels. Construction of the meter is described with underlying operating principles, making it easy for anyone to understand the mechanism's inner workings. Anemostat Corp. of America.

125 **Shielded Rotameter**—Four-pp Bulletin is devoted to a full-view rotameter with safety shielding and with screwed or flanged connections. Contains photos of both types and front and side sectional drawings. Explains the low maintenance, corrosion resistance, operating safety and high accuracy credited to this rotameter and describes and illustrates standard modifications. Includes complete dimensional data. Brooks Rotameter Co.

PUMPS, COMPRESSORS

126 **Turbine Pumps**—Illustrated Bulletin 1013, 7 pp, features manufacturer's oil lubricated pumps for many industrial applications. By means of large cutaway illustrations it shows pumps' construction and operation and special impeller design features. Text discusses the economy of their interchangeability of parts and their adaptability to any power source. Johnston Pump Co.

127 **Axial Flow Compressors**—The design features, construction and operation of axial flow compressors for electric, steam or gas turbine drive are described and illustrated by photo and sectional drawings in Form No. CH-1148, 8 pp. Gives advantages of these compressors for large volume application. Clark Bros. Co., Inc.

HEAT EXCHANGERS

128 **Heat Exchanger Design**—A positive seal type of baffle utilized in manufacturer's two-pass shell heat exchangers is presented as a solution to a common heat exchanger problem in this 4-pp bulletin. It describes and illustrates this baffle construction in detail. Also illustrates other lines of equipment manufactured by company. Henry Vogt Machine Co.

129 **Tubular Heater**—A simplified vertical tubular heater suitable for every process duty and designed to hold initial and maintenance costs to a minimum, is the subject of 4-pp Bulletin 0-49-7. Includes a complete description of this simplified design which features the use of bare tubes and the absence of any metal parts exposed to furnace gases, also a discussion of the design's advantages. Cutaway drawings illustrate text. Foster Wheeler Corp.

130 **Jacket Water Coolers**—Catalog 1349, 16 pp, complete with illustrations of typical installations, presents in detail specifications and ratings of manufacturer's entire line of jacket water coolers for gas, gasoline and Diesel engine cooling. Includes 12 models capable of dissipating from 505,000 to 2,270,000 Btu per hour in water cooling service under standard conditions, 12 models of from 151,000 to 490,000 Btu capacity and a compact, low cost unit designed for use on gas and Diesel pumping engines of about 40 hp. Also illustrates and describes accessories, including three types of cores. Young Radiator Co.

SAFETY

131 **Oxygen Unit**—Power engineers will be interested in the new oxygen therapy unit for administering oxygen on a demand-regulated basis which is described in Bulletin CW-3, 2 pp. With this unit the patient's safety is always assured, the bulletin states, because the oxygen flow automatically adjusts to individual breathing needs. Bulletin recommends this lightweight unit for dispensaries, plant hospitals and first-aid rooms for the treatment of gas poisoning, heart failure and other conditions where oxygen treatment is indicated. Describes operating principle, range of applications. Mine Safety Appliances Co.

132 **Fire Extinguishers**—How a new tinning process doubles the life of manufacturer's fire extinguishers by protecting metal from corrosive action is explained in 2-pp illustrated Bulletin AD11004. Also discusses the construction and operation of these extinguishers. American-LaFrance-Foamite Corp.

MATERIALS HANDLING

133 **Car Shakeout for Small Plants**—Bulletin 130, 4 pp, features a new lighter-weight car shakeout designed to unload up to 15 hopper bottom cars per day and priced for the two-car-a-day market. Contains many photos of the skakeout in operation. Text covers its application and economy in terms of time and hand labor saved. Dimensions given. Robins Conveyors Div., Hewitt-Robins, Inc.

134 **Belt Feed Scale**—Bulletin 1549, 4 pp, describes and illustrates an automatic bulk weighing scale of the belt feed type for weighing lumpy, crushed and sluggish materials. Description of scale's operation is accompanied by diagram showing essential working parts. Lists dimensions, capacities; gives specifications, and discusses applications. Richardson Scale Co.

135 **Rolling Ring Crushers**—Bulletin R-41101, 6 pp, covers a rolling ring crusher for economical reducing of coal

(Continued on page 100)

SEPTEMBER, 1949

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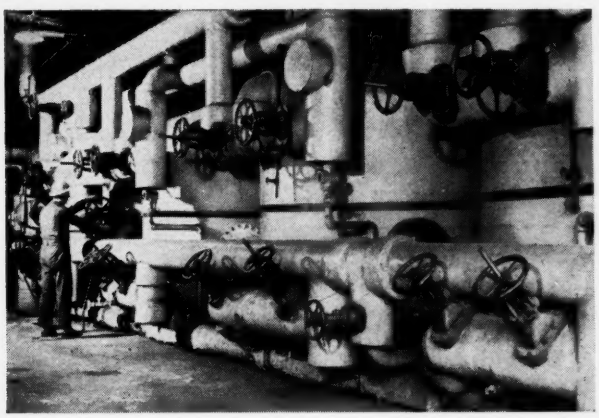
DOWELL

SPECIALISTS IN SCALE AND SLUDGE REMOVAL WITH CHEMICALS

Filters cleaned in 7 hours



by Dowell Service

Quick, effective cleaning of industrial filters and filter beds now possible with Dowell Service

Three coal filters in a municipal power plant had been in use for three years. Although back washed weekly they were almost plugged with carbonate scale. *In less than seven hours*, Dowell Service restored the units to a high degree of efficiency. For most industrial filters and filter beds, as well as all types of heat exchange equipment, Dowell Service is the best answer for fast, economical cleaning.

Special solvents, selected to fit the particular scale problem, are pumped into the equipment utilizing existing connections. When the troublesome scale is dissolved or disintegrated, the spent solution is removed. The unit is then flushed out and put back into operation. No dismantling or modification of equipment is required—costly down time is minimized.

Dowell Service has been proved best in hundreds of cleaning operations. Skilled engineers, specialized equipment, and step by step control make Dowell the logical answer to your cleaning problem.

Call on Dowell for your next scale removal job. There is a Dowell office near you. Ask for a free cost estimate now.

DOWELL INCORPORATED · TULSA 3, OKLAHOMA

SUBSIDIARY OF THE DOW CHEMICAL COMPANY

CALL

New York 20	Cleveland 13	Wichita 2	Hamilton, Ohio
Boston 16	Pittsburgh 19	Oklahoma City 2	Charleston 27, W. Va.
Philadelphia 2	Detroit 2	Houston 2	Salem, Illinois
Baltimore 18	Chicago 2	New Orleans 12	Borger, Texas
Wilmington 99	St. Louis 8	Ft. Worth 2	Midland, Texas
Richmond 19	Indianapolis	Shreveport 69	Wichita Falls, Texas
Atlanta	Louisville	Anniston, Alabama	Lafayette, La.
Buffalo 2	Kansas City 8	Mt. Pleasant, Mich.	

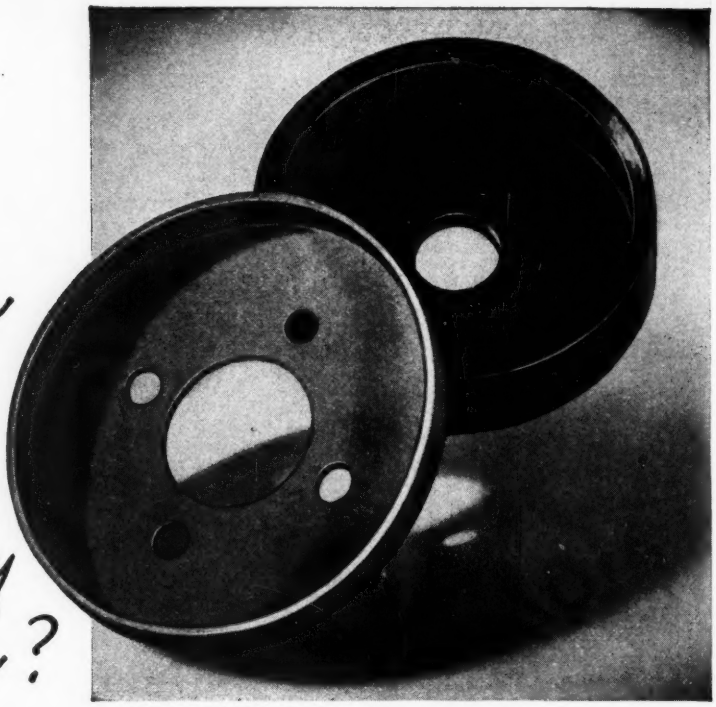
Long Beach, Oakland, Casper: Dowell Associate—International Cementers, Inc.

DOWELL

A SERVICE ORGANIZATION

QUESTION:

What leather packing is recommended for unusually severe service?



*Reg. U.S. Pat. Off.

ANSWER:

Garlock BITAN*

Special tanning and treating of selected leathers by exclusive Garlock processes, gives Bitan high tensile strength to withstand the heaviest pressures; also it makes the leather resistant to higher temperatures than leathers of standard tannage and treatment.

In filling each order, GARLOCK BITAN* Leather Packings are properly tanned and treated for the particular service for which the finished product is used. All types or forms including: Molded Cups, "U" and "V" Packings, Flange or Hat Packings, Gaskets, Washers, and Discs. All sizes. Write for descriptive folder.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

GARLOCK

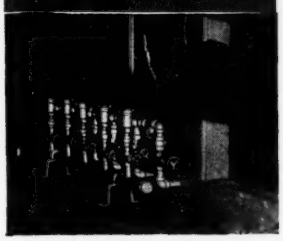
PACKINGS, GASKETS AND OIL SEALS

WHAT ARE YOU PAYING *for Condensate?* $ $ $ $

If your steam heated equipment is not supplied with hot, dry steam kept in intimate contact with the heated surface and free from air, you are paying for fuel that is being thrown away every hour.

Worse yet, you are paying double in lost production and rejects, if your equipment is not properly trapped and vented.

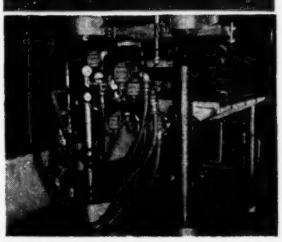
AUTOS



$ LOST TIME

Heating up time was reduced from 3 hours to 1 by using Sarco No. 9 Thermostatic Traps on enamel ovens in a large auto body plant. This trap has large air venting capacity. Removes condensate at 10°F below steam temperature.

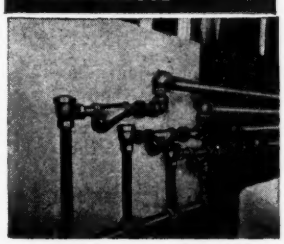
PLASTICS



$ REJECTED GOODS

With seven platens on this large plastics press, the weakest link (one cold section) made rejects frequent and without notice. Now seven Sarco Bucket Traps kick out the condensate and provide trouble-free production. This trap is ideal for releasing condensate as quickly as it forms—a must on plastics presses.

GREENHOUSE

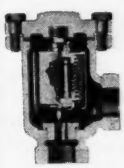


$ LOST FUEL

Most manufacturers don't know how much fuel they are losing due to inefficient trapping. In greenhouses, where fuel is a large part of the cost, monthly fuel bills tell the story fast. This greenhouse saved 30% of the fuel and 60% of the make up water by using Sarco Thermostatic traps on every line and every coil.

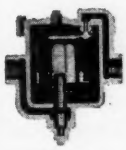
FOUR TYPES OF SARCO STEAM TRAPS TO CHOOSE FROM

Sarco makes all accepted types and can fit the trap to the job. Ask for trap selection chart No. 1600.



THERMOSTATIC

FLOAT-THERMOSTATIC



BUCKET

LIQUID EXPANSION

251

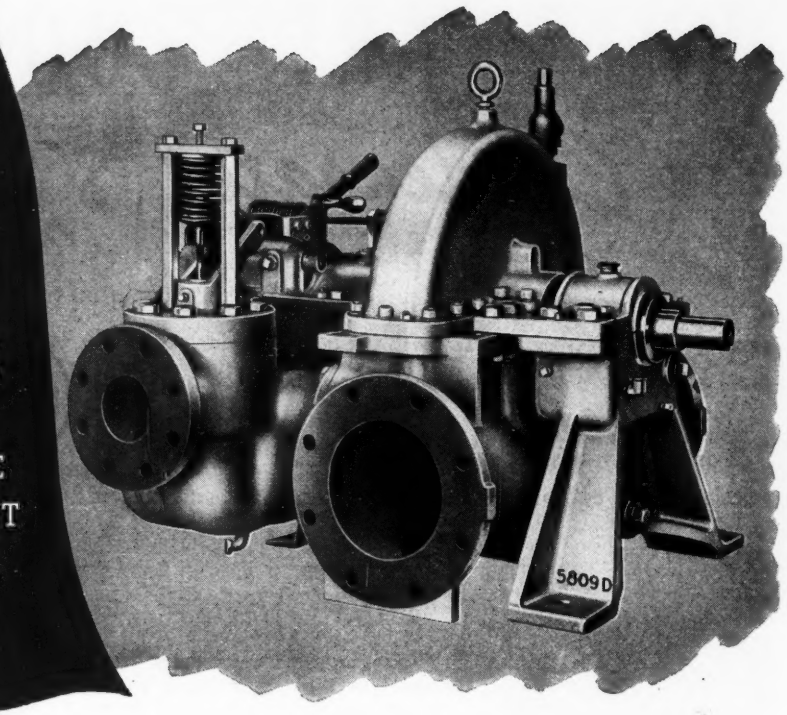
SARCO SAVES STEAM

SARCO COMPANY, INC.
Represented in Principal Cities
Empire State Building, New York 1, N. Y.
SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

These Optional Features

GIVE YOU THE MOST EFFICIENT TURBINE FOR ANY JOB



You don't have to penalize efficiency, increase operating costs or suffer inadequate performance because the best you can get is a "compromise" turbine. The wide variety of sizes and features offered by De Laval enables you to pick a turbine exactly suited to your operating conditions.

Choice of frame sizes

De Laval single stage turbines are made in three frame sizes with wheels 16", 20" and 25" in diameter for capacities from below 50 HP to more than 1500 HP.

Choice of steam conditions

Up to 600 psi and 750°F exhausting at pressures up to 250 psi.

Choice of speed control

Horizontal mechanical shaft governor control available for speeds up to 4500 rpm. Vertical geared mechanical and hydraulic governors for speeds up to 7000 rpm and precision controlled hydraulic relays. Remote control operation and pressure responsive controls also furnished.

Choice of hand valves

Hand valves are supplied for controlling steam admission to attain efficiency at partial loads or with varying steam pressures.

Whatever your operating conditions, De Laval gives the most efficient turbine for the job.

Before you buy, be sure and check these additional De Laval features:

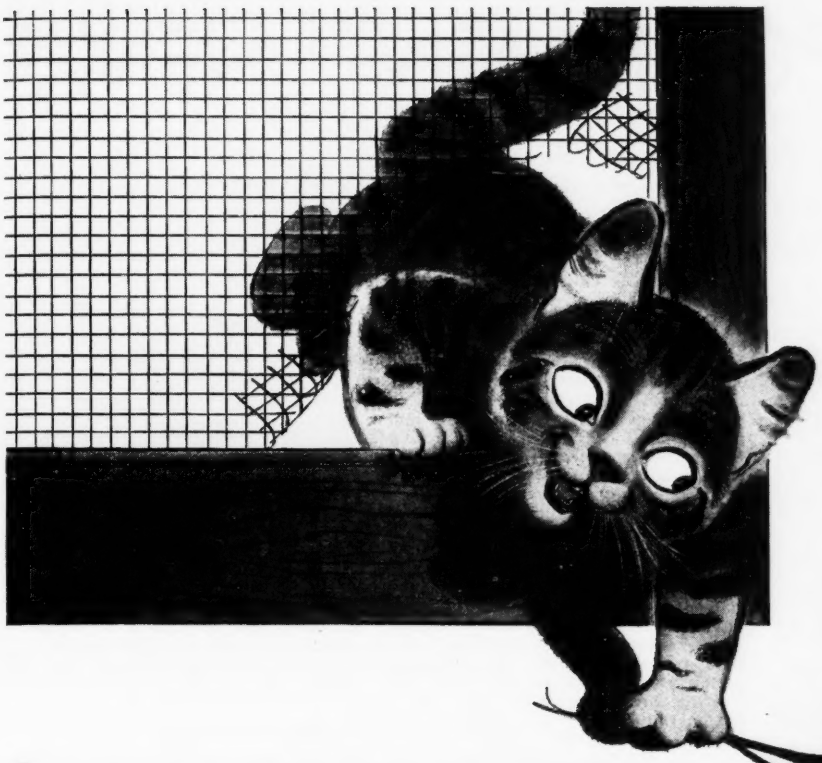
- True center line support and flexible mounting for perfect alignment.
- Balanced double-seated bonnet-type governor valves for close control of steam flow.
- *Positive* over-speed protection entirely separate from normal speed governor for unfailing emergency shut-off.
- Sensitive, friction-free, wear-resistant "rocking chair" governor pivots.
- Super-smooth, chrome plated shaft journals make carbon rings last longer.
- Casing and bearings split horizontally at center line for easy removal and inspection of the rotor, carbon rings and bearings.

SEND FOR CATALOG 4202-25-G

DE LAVAL STEAM TURBINE COMPANY, TRENTON 2, N. J.

TURBINES • HELICAL GEARS • CENTRIFUGAL BLOWERS AND COMPRESSORS
CENTRIFUGAL PUMPS • WORM GEAR SPEED REDUCERS • IMO OIL PUMPS

T-25



*PENETRATION

Peak production . . . without worry of breakdown due to friction and wear . . . is made easier with Tycol high quality greases.

Made to "absorb punishment" without thinning down and dripping, Tycol greases avoid wasted lubricant, lost bearings and unnecessary down-time. These ultra-safe lubricants keep bearings . . . gears . . . shafts . . . friction-free and cool. They are available in grades with the proper "*PENETRATION" needed to give power a chance to produce with a minimum of waste.

Call your nearest Tide Water Associated office. Let them suggest the Tycol grease best suited to your needs . . . and remember, Tycol green cast greases are made from high quality cylinder stock and well refined neutral oil, with a minimum of soap — a maximum of oil . . . more efficient lubrication per pound of grease.

TYCOL

INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh • Philadelphia • Chicago Detroit • Tulsa • Cleveland San Francisco • Toronto, Canada

TIDE WATER ASSOCIATED OIL COMPANY

17 BATTERY PLACE - NEW YORK 4, N.Y.

*LEARN WHAT THIS PRODUCT CHARACTERISTIC MEANS TO YOU — READ "LUBRICANIA" This informative handbook, "Tide Water Associated Lubricania," gives clear, concise descriptions of the basic tests used to determine important properties of oils and greases. For your free copy, write to Tide Water Associated Oil Company, 17 Battery Place, New York 4, N. Y.

REFINERS AND MARKETERS OF VEEDOL — THE WORLD'S MOST FAMOUS MOTOR OIL

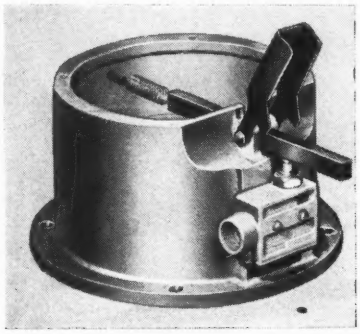
NEW EQUIPMENT NEWS

WHAT'S NEW? On these pages the Editors summarize the outstanding industrial developments of leading manufacturers who will supply you, free of charge, the bulletins or other information desired. For ease in making requests use the no-obligation, postage-paid card, pages 35-36

1—SPEED LIMITING DEVICE

For use with motors, generators and motor generator sets

Adaptable to an extended speed range from 100 to 2000 rpm, these limiting devices have weight and tension spring combinations to suit speed ranges within the overall range. Their improved design is said to result in an accuracy of approximately ±2 per cent for higher speeds and ±5 per cent for lower speeds.



The device is suitable for horizontal or vertical operation. Its rotating element is balanced about the axis of rotation to assure freedom from vibration and a trip arm guard is provided to prevent accidental actuation of the tripping mechanism. While each speed limiting device is set at the factory for operation at about 15 per cent overspeed for rated speeds up to 500 rpm and 10 per cent overspeed for higher rated speeds, adjustments can be made at the plant. Allis-Chalmers Mfg. Co.

2—DRINKING WATER COOLER

Has generous cooling capacity, large cold storage compartment

The new Oasis, bubbler-type, electric drinking water cooler, Model OP-3R,

is equipped to cool more than 3 gal of water to 50F and provide adequate storage space for 28 small beverage bottles or seven tall, quart bottles. Monel metal is used for the interior of the compartment and door liner. The compartment has snap-fastener and pilfer-proof lock with keys. Defrosting is unnecessary, since no frost is formed. But provisions have been made for draining off spilled liquids.

Temperatures in the compartment have a range of 36 to 46F and may be quickly lowered or raised, as the temperature control is readily accessible. However, the switch for controlling the water temperature is located underneath the front panel. Finished in antique-brown, opalescent lacquer, the cabinet is constructed of heavy-gauge, galvanized and Bonderized steel. The stainless steel top is fitted with angle-stream, bubbler valve. Equipped with a quiet, hermetically sealed, condensing unit, this cooler is warranted for five years. The Ebco Mfg. Co.

3—PANEL INSTRUMENTS

In 2½ in. size for use in electronic devices, testing equipment

This improved line of 2½ in. panel instruments for use in apparatus offering only limited mounting space is identified as Types DW-71 (direct current), DW-72 (thermocouple), DW-73 (rectifier), and AW-72 (iron vane). The instruments feature stylized cases, tapered pointers and scales with large, easy-to-read numerals, and are available in square or round cases in preferred ratings. Housed in dustproof and moisture-resisting black molded Textolite cases, these instruments are described as accurate within ±2 per cent. Meter and Instrument Divs., General Electric Co.

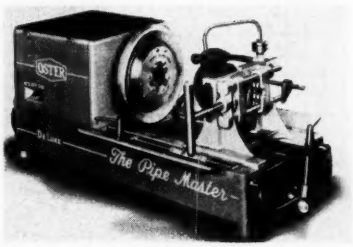
4—PIPE AND BOLT THREADER

Is portable, intended for light socket connection

The No. 522 De Luxe Pipe Master, of aluminum construction, has a regular pipe range of ¼ to 2 in. pipe; extra range of ⅛ in. pipe; extended range of 2½ to 8 in. pipe when used with drive shaft and geared die-stock; and a bolt range of ¼ to 1½ in. The machine has a universal geared head motor and safety switch for operation on 110 v either a-c single phase or d-c (220v optional at no extra cost).

Two stationary, quick-opening and adjustable die-heads are standard equipment. Rear chuck is self-centering. A roller-type self-centering cut-off gage is calibrated for easy setting for any length of nipple up to 6 in.

Flat bedways are replaceable after long service. Hinged mounting of motor,

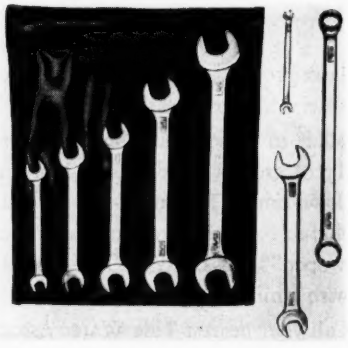


switch and pump makes those parts accessible for inspection and maintenance. Machine is regularly furnished for bench use, but can be furnished on a steel stand with 16 in. plain wheels or on a pipe leg stand with tool tray. Net weight, machine only, is about 229 lb. The Oster Mfg. Co.

5—END WRENCHES

In six new models, and two new sets are now available

Two of these new Proto wrenches are the open end type. No. 3016, with 3/16" and ¼" openings, fits No. 2 and No. 3 small and No. 4 large American Standard regular nuts. No. 3033, with 19/32 and 11/16 in. openings, fits 5/16 and 3/8 in. American standard heavy nuts and U.S.S. boltheads and nuts. A third new wrench is No. 1133, a double-end 12-point box type. Its openings are 19/32 and 11/16 in.



The other three new wrenches are the combination box and open end type. No. 1208, with ¼ in. openings, fits the No. 4 machine screw nuts and is needed for instrument and electrical work. Its hex box opening prevents rounding bolt and nut corners. No. 1248, with 1½ in. openings, and No. 1252, with 1 5/8 in. openings, are for tractors, diesel engines, truck axles and heavy industrial jobs.

A new Proto set is No. 3000N, with

USE THE NO-OBLIGATION, POSTAGE-PAID CARD ON PAGES 35-36

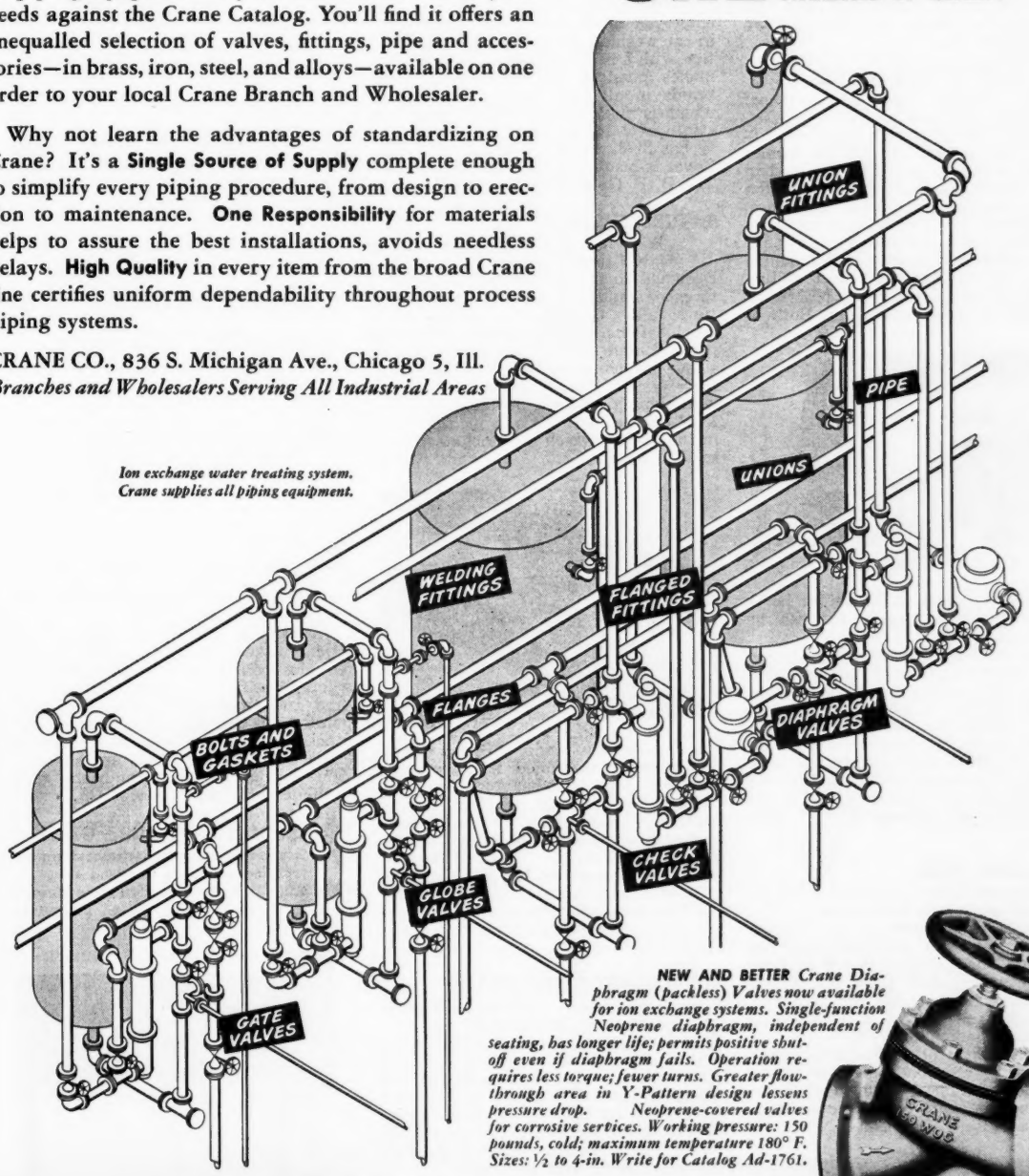
For process piping in ion exchange ...CRANE has everything you need

In ion exchange—whether for water treating systems, as shown here, or for any other process—Crane can supply all piping equipment for your installation. Check your needs against the Crane Catalog. You'll find it offers an unequalled selection of valves, fittings, pipe and accessories—in brass, iron, steel, and alloys—available on one order to your local Crane Branch and Wholesaler.

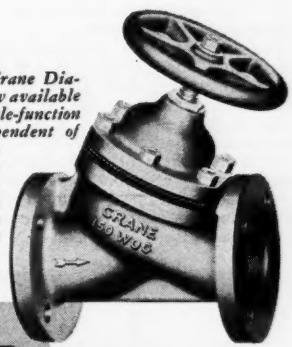
Why not learn the advantages of standardizing on Crane? It's a **Single Source of Supply** complete enough to simplify every piping procedure, from design to erection to maintenance. **One Responsibility** for materials helps to assure the best installations, avoids needless delays. **High Quality** in every item from the broad Crane line certifies uniform dependability throughout process piping systems.

CRANE CO., 836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

ONE SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY



Ion exchange water treating system. Crane supplies all piping equipment.



NEW AND BETTER *Crane Diaphragm (packless) Valves now available for ion exchange systems. Single-function Neoprene diaphragm, independent of seating, has longer life; permits positive shut-off even if diaphragm fails. Operation requires less torque; fewer turns. Greater flow-through area in Y-Pattern design lessens pressure drop. Neoprene-covered valves for corrosive services. Working pressure: 150 pounds, cold; maximum temperature 180° F. Sizes: ½ to 4-in. Write for Catalog Ad-1761.*

EVERYTHING FROM . . .

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

CRANE

FOR EVERY PIPING SYSTEM

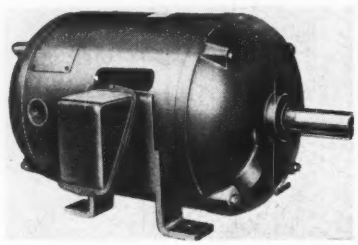
Mark the numbers of the items you wish to receive on the no obligation, no postage card. Pages 35-36.

five open end wrenches in a flexible kit. Is useful for automotive, machine and other maintenance. Another set, No. 1200H, has seven combination box and open end wrenches in a flexible kit. Plomb Tool Co.

6—WOUND ROTOR MOTOR

Is protected type, with dripproof frames and end shields

The Form BW Protected Type wound-rotor motor is built in NEMA frames 224-505 in ratings up to 100 hp, and in larger frames up to 200 hp. In addition to the standard dripproof enclosure, these motors are available splashproof, and totally-enclosed non-ventilated. Other mechanical modifications include NEMA floor-, sidewall-, and ceiling mounting assemblies, and NEMA C face and D flange mountings. Both of



the latter types are available for horizontal or vertical operation, with or without feet.

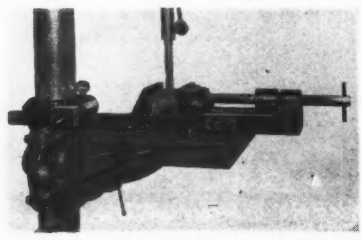
These motors are designed for applications requiring smooth acceleration, high starting torque with low starting current, ability to start and stop or reverse frequently, or variable speed. They are recommended for driving conveyors, crushers, printing presses, fans, centrifugal compressors. Special windings available for crane and hoist service. The Crocker-Wheeler Electric Mfg. Co.

7—COLUMN VISE

Clamps to the column of single or multiple spindle drill presses

Because a single turn of the handle frees the jaws for push-pull opening or closing, the Col-Vise is said to save time on typical drill press operations, and making simple jigs and fixtures. Vise itself has 1½ by 4 in. jaws and a maximum opening of 6 in.

Models to fit drill presses with either stationary or movable tables are available. Columns of 1-7/16 through 3-29/32 in. dia. can be accommodated. Universal Vise & Tool Co.



8—RUBBER SPRAY HOSE

Is made to utilize working pressures as high as 800 psi

This spray hose is made in long lengths and designed to handle many sprays previously destructive to rubber hose.

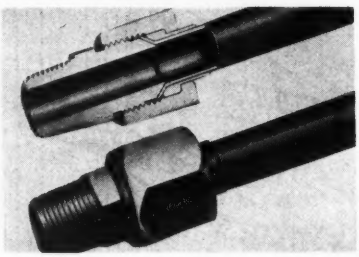
Manufacturer says the new hose has greater strength and less friction loss because of the extremely smooth tube employed.

Compounds of oil resistant rubber make the hose highly satisfactory for use with oil emulsions. It can also be employed on hydraulic equipment and in car washing units. Braided construction with a new high tensile cotton yarn makes possible the use of only two braids in all sizes except the 3/4 in. which is made in three braids. The 3/8 size has 13/16 in. OD. 7/16 has 7/8 in. ½ has 31/32 in. and 3/4 has 1 5/16 in. Cover is black, lead press molded finish. The B. F. Goodrich Co.

9—TUBE FITTINGS

With special locking feature, come in 477 shapes and sizes

Designed to meet Joint Industry Conference standards, the Triple-lok fittings also conform to Army-Navy specifications. The Triple-lok is a three piece flared fitting incorporating a sleeve which is intended to act as a lock-washer, damp vibration and prevent wiping of flare during make-up. A 37 degree flare angle is incorporated in the design, which also includes Dryseal pipe threads.



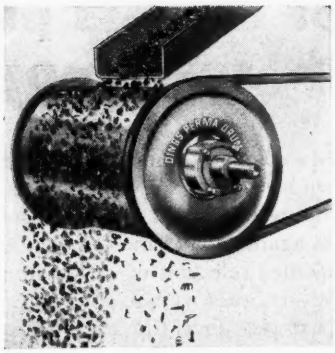
All parts are made of steel, shape bodies being machined from forgings and other parts from bar stock. Stainless stocked include male and female connectors, elbows, run tees, outlet tees, union, union tees and bulkhead unions. Sizes range from No. 2 (⅛ in. tube OD, ⅛ in. pipe thread) to No. 32 (2 in. tube OD and pipe thread), including dual combinations of tube and pipe sizes commonly used. The Parker Appliance Co.

10—MAGNETIC SEPARATOR

Is permanent, drum type for automatic tramp iron removal

This non-electric Alnico magnetic separator, complete with shaft and V-belt drive sheave, can be installed at the discharge end of chutes, spouts and conveyors for processing feed, grain, rubber, glass, fertilizer, chemicals plastics, tobacco, minerals, food, coal, sand, textiles, metals and powders.

Features include: circumferential pole design for uniformity of magnetic field across drum width; adjustable dual-purpose leveler and burden feed control. The non-magnetic wear-and-abrasion-resistant manganese alloy steel drum shell revolves on sealed, self-aligning ball bearings while the non-electric Alnico magnet inside the drum shell remains stationary. Non-magnetic material flows over the drum



shell in a normal trajectory. The tramp iron holds to the drum by magnetic pull, dropping off when it passes out of magnetic field. There is said to be no drum shell wear from adhering tramp iron.

Also available in types which have the Perma-Drum fully enclosed. Available in capacities from 710 to 8500 cu. ft. per hr. Dings Magnetic Separator Co.

11—OPERATING PLUG VALVE

For high and low vacuum service on lines carrying gas or liquids

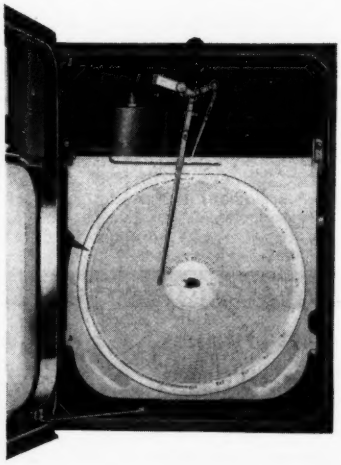
This operating plug valve involves an eccentric plug face and an eccentric raised seat in the valve body. The plug, carried on journals at both ends, contacts the body seat only when the valve is completely closed. When the plug begins to rotate, the face is immediately released from contact with the body seat with no seizing, binding or scoring. Line pressures, which may go as high as 150 psi will not distort or stretch this rubber sealing member, according to manufacturer.

The Hycar face of the plug is intended to eliminate dripping. A perfect closure is said to be obtained even when the flow contains rust, scale, sand and abrasive slurries. It is also pointed out that the rubber-faced plug functions with less wear and possesses longer life because of its abrasion resistance, high tensile strength and good resilience. DeZurik Shower Co.

12—ABSOLUTE PRESSURE GAGE

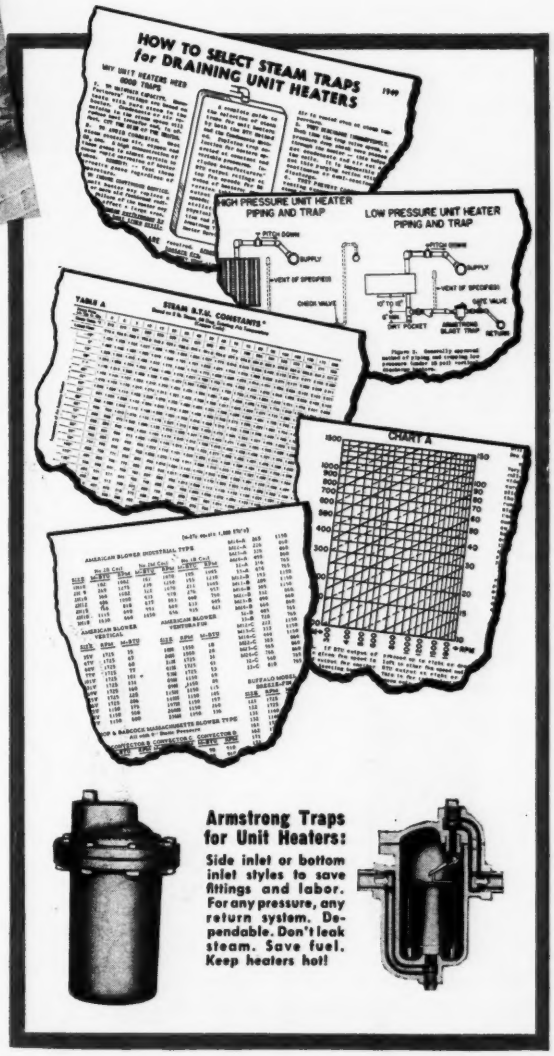
Is mechanical type instrument for recording extremely low ranges

This gage is based on a new principle, described as involving a pressure-



HOW TO SELECT UNIT HEATER TRAPS

1. To obtain full BTU output
2. To insure continuous service
3. To avoid corrosion


HOW TO SELECT STEAM TRAPS for DRAINING UNIT HEATERS
HIGH PRESSURE UNIT HEATER PIPING AND TRAP
LOW PRESSURE UNIT HEATER PIPING AND TRAP
STEAM R.S.M. CONSTANTS
CHART A

THE ANSWERS are in a new 8-page handbook prepared by Armstrong! Only thing of its kind, this manual explains why it is important to use dependable traps that are properly sized and that will discharge condensate and corrosive incondensable gases at steam temperature; tells how to select traps by the BTU Method and the Condensate Weight Method; includes tables of BTU outputs of the heaters produced by 24 different manufacturers; discusses heater manufacturers' recommendations on types of traps to use and methods of installation; and includes tables and charts for working trap selection problems.

Anyone is welcome to a copy of this helpful guide to better unit heater performance. Address your request to:

ARMSTRONG MACHINE WORKS

810 Maple St., Three Rivers, Michigan

Armstrong Traps for Unit Heaters:

Side inlet or bottom inlet styles to save fittings and labor. For any pressure, any return system. Dependable. Don't leak steam. Save fuel. Keep heaters hot!

ARMSTRONG Inverted Bucket STEAM TRAPS

Over a Million in Use... For Power... Process... Heating

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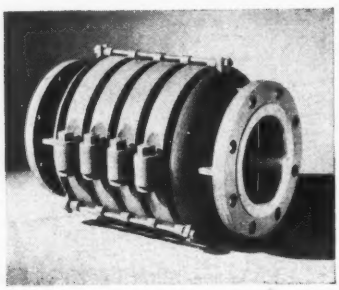
sealed lever arm so constructed that it is frictionless, entirely free from lost motion, and free of turning, moments due to changes in differential pressure across it. Known as the Series 500 Recording Absolute Pressure Gage, the instrument is offered in ranges from 0 to 20 millimeters mercury up. Rugged in construction, it is intended for use under ordinary plant conditions, and is designed to give an accurate record of vacuum in terms of absolute pressure, inherently correct for barometric variations. The new instrument is offered as a recorder, as an automatic controller, and for remote measurement and automatic control of absolute pressure. The Bristol Co.

13—EXPANSION JOINT

Is suited for use in remote and difficult-to-service locations

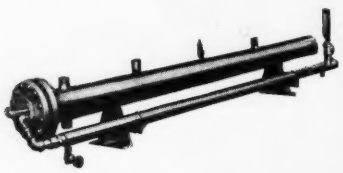
With the Adsco "Corruflex" Expansion Joint more economical installations are said to be possible, since its compactness permits use in trenches, tunnels or other cramped quarters. "Corruflex" is available in sizes from 3 to 24 in., single or multiple corrugation, with or without self-equalizing rings, single or double units, and with either flanged or welding ends. Supplied in copper, stainless steel or other alloys, and with internal sleeves, if required. The traverse joint ranges from fractions of an inch to 15 in., and will operate under pressures from vacuum to 300 lb, and temperatures from sub-zero to 1600 F. American District Steam Co.



15—CONTINUOUS BLOWDOWN

Automatically and continuously removes impurities from boiler

The Packet Type Continuous Blowdown also saves heat by transferring it from the blowdown water to the incoming feedwater. This compact and inexpensive unit is designed for installation with any boiler under 500 hp. Completely automatic, it is engineered to give a definite and correct blowdown regardless of variation in boiler load, and to permit an accurate control of concentration.

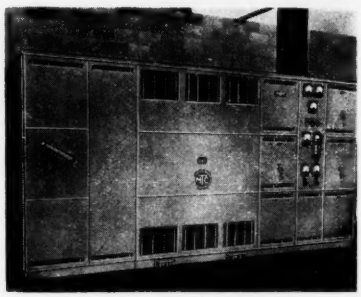


A simple automatic control is set to establish the amount of continuous blowdown in proportion to the quantity of make-up water and its impurities. This control then regulates the amount of blowdown for variations in the amount of make-up water added to the boiler system. The heat from the blowdown water is returned to the boiler by means of the heat exchanger. This is said to result in substantial dollar savings. The Henszey Packet Blowdown comes completely assembled and ready to operate. Henszey Co.

16—UNIT SUBSTATION

Is air-cooled, dry type with choice of protective equipment

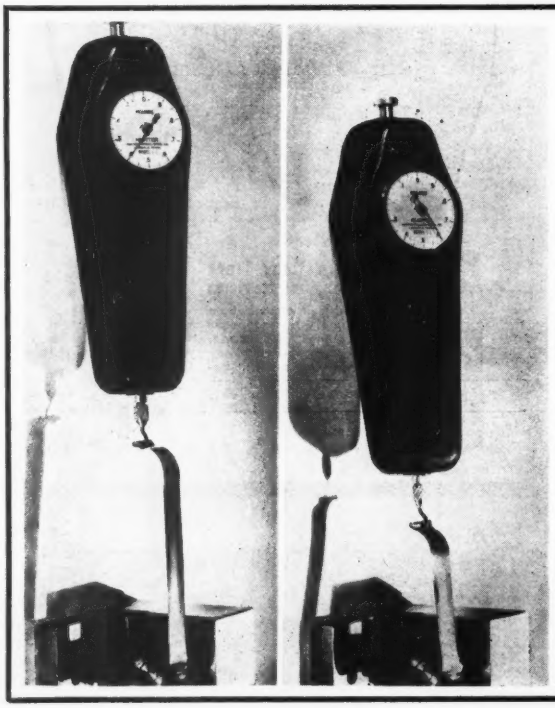
The complete power package consists of a dry type transformer, primary protection, secondary breakers and metering equipment. A choice of primary and secondary protective equipment is offered to meet user's needs. The transformer section is constructed throughout with Class B and C heatproof insulation. This substation is described as ideal for industries where safety and convenience are important factors. Available in sizes from 100 to 2000 kva, both single and three phase, up to 15,000v. Primary 4160 v delta; secondary 120/208 Y, four wire. Marcus Transformer Co., Inc.



17—MAGNETIC PLUGS

Come in standard square head, countersunk, and special designs

These plugs, ranging in size from ¼ to 1½ in., are described as having prop-



The force of the Neg'ator, as shown, decreases one-third with a 2-in. deflection

14—NEGATIVE SPRING

. . . stretch it and the force decreases

Contrary to accepted principles, the Neg'ator spring resists less the more it is deformed.

The invention of W. J. Cook, Hunter Spring Co., it is credited with four other unusual properties:

1. great expandability and range of action;

2. ability to act around corners and through small openings with the freedom of non-elastic bands;

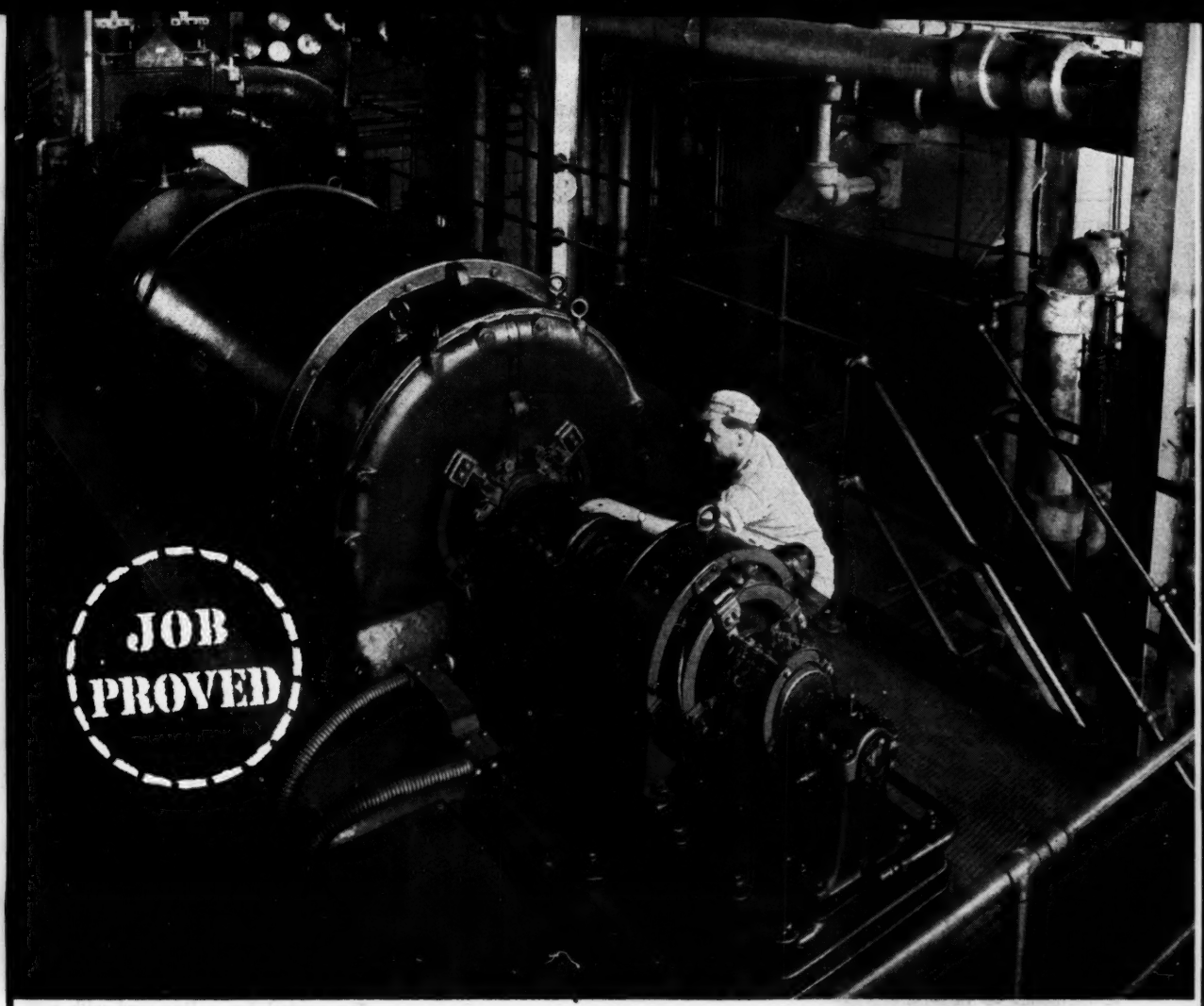
3. high initial force in resisting first increments of deflection;

4. ability to store and deliver about twice as much energy as spiral or power springs.

The Neg'ator is described as a tight coil of flat material progressively unwound over the range of Neg'ator action. In manufacture, this material is so prestressed that it has a strong natural curvature and requires much force to straighten it.

In use, either the free outer end of the coil may be pulled, with the yet-unwound coil left free to rotate on its natural axis; or the opposite ends may both be coiled about shafts, in which case the opposing forces are torques.

Uses predicted for it include compression or extension springs, self-adjusting clamps, clips, precision force adjustments, transducers, automatic coiling devices, telescoping tube forms, for stabilizing (dash-pot) uses and means of transmitting power or motion.



PROTECTED BY SUNVIS 916

Turbine Bearings and Journals Corrosion-Free Despite Summer Shutdowns — Oils Like New After 9,000 Hours

Three years ago, a paper mill overhauled a steam turbine. Thereafter, it was planned to operate this equipment on a 'round-the-clock schedule during the six winter months, and completely shut down in the summer. On the advice of a Sun Engineer, the mill charged the circulating system supplying turbine, generator journals, and governor with Sunvis 916. This oil was chosen because of its "Job Proved" ability to prevent rust and corrosion and to give troublefree lubrication for a long period of time.

The management's selection of Sunvis 916 proved to be sound. After 9,000 hours, a laboratory analysis of the oil showed it to be unchanged—comparable to a sample of new oil. Even more important, inspection showed no abnormal wear and no corrosion in bearings and journals, despite the summer-long shutdown.

The turbine has now operated 12,000 hours without oil-change, and it appears that none will be necessary in the foreseeable future.

All oils in the Sunvis 900 series have a high viscosity index, are fortified against oxidation and sludging, and prevent rust and corrosion. Sunvis 900 Oils are the finest lubricants available for turbines, hydraulic systems, and similar applications. For a free, illustrated booklet on Sunvis 900 Oils, write Department PN-9.

SUN OIL COMPANY · ***Philadelphia 3, Pa.***
In Canada: Sun Oil Company, Ltd.
Toronto and Montreal

SUN PETROLEUM PRODUCTS
"JOB PROVED" IN EVERY INDUSTRY

SUNOCO

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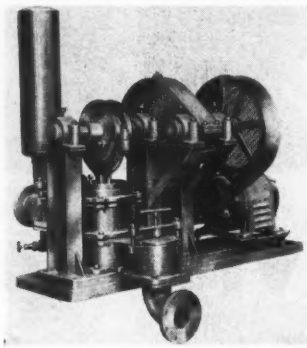
erties that will remove and hold ferrous metal particles from a moving lubricant. In them, the magnet is placed in the lubricant stream. Their construction is intended to permit easy cleaning by a blast of air. Magnets are of sintered Alnico with tractive force of 11 oz, and are attached to the plug with a non-ferrous metal stem. All of these plugs are threaded with Dryseal threads and are interchangeable with any standard Briggs type pipe thread. U. S. Plug & Fitting Co.

18—NEW PUMPS

Diaphragm and plunger types for heavy pumping requirements

Presented in this extensive new line are motor- and engine-driven diaphragm and walking-beam plunger pumps and eccentric drive plunger sludge pumps. They have many applications and, according to manufacturer, will pump liquids so heavy as to be nearly solids including viscous and clotted compounds and trash-laden liquids.

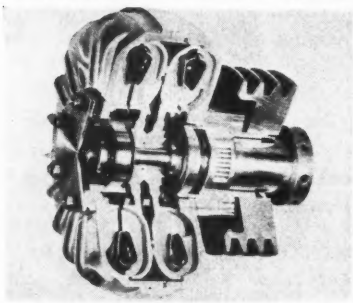
Eccentric drive plunger sludge pumps are included in the line. Type PE, shown, is powered by a standard horizontal motor, V-belt transmission and reduction gearing. Also supplied with vari-drive motor for use where application requires varying capacities. In 4- and 6-in. sizes, capacities from 3000 to 14,000 gal per hr. Marlow Pumps.



19—HYDRAULIC SHEAVE DRIVE

Is low cost conversion device for use on small power units

Specially designed to be used on Quick Detachable Sheaves is this new hydrau-



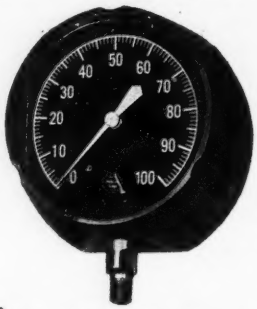
lic drive manufactured by the Twin Disc Clutch Co. It is said too have advantages of a fluid drive and be applicable to electric motors and internal combustion engines in the ¾ to 25 hp range.

When combined with a sheave, this drive is an integrated power transmission package, complete with installation instructions, parts drawings, parts list and single wrench required for mounting. The small aluminum hydraulic coupling is filled with hydraulic fluid and bearings are lubricated for life, it is stated, and when used with general purpose a-c motors heavy loads are started easily and accelerated rapidly. Worthington Pump and Machinery Corp.

20—PRESSURE GAGE

In smaller size, has 3½ in. dial, and external pointer adjuster

This smaller size Helicoid Gage is made with a steel Bourdon tube and is recommended as particularly adaptable for ammonia ice machines, pumps, com-

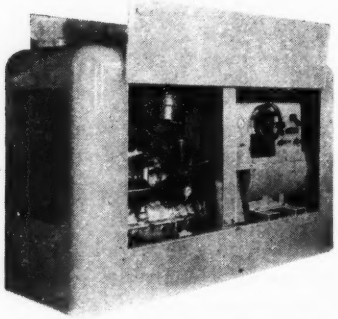


pressors and hydraulic presses up to 10,000 psi. It has the same features as manufacturer's larger gages, including the same movement, stainless steel bearings, fused joints. Helicoid Gage Div., American Chain & Cable Co., Inc.

21—HEAVY DUTY ARC WELDER

For pipeline work and wherever ruggedness and durability are important

Known as the Wilson 36A Yellow Jacket, this machine is built in 300 and 400 amp sizes and is described as a d-c



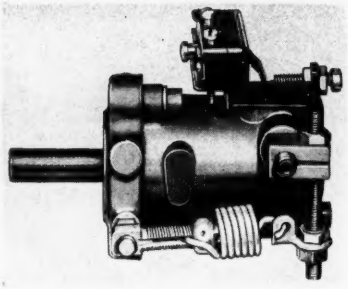
40-v NEMA approved variable voltage generator. It is said to feature simplified control of current output by a hand-wheel on the control cabinet.

The Yellow Jacket 36A is a two-bearing unit, engine driven by sheaves and steel cored V-belts. It is powered by a six-cylinder industrial engine and available in stationary or portable models. It is 76 in. long, 28 in. wide and 49 in. high. Air Reduction Sales Co.

22—MICRO SWITCH CONTROL

Is available in direct drive or cable driven centrifugal governors

This micro-switch centrifugal governor is designed to turn off motor, engine or other electrically energized equipment



when a pre-determined speed limit has been exceeded. According to manufacturer, the micro-switch governor is especially recommended for situations in which investigation or corrective measures must be taken before "runaway" equipment is put back into operation.

The micro-switch must be reset manually before the motor can be started again, so equipment is protected until the leak is repaired. The micro-switch feature is available on manufacturer's direct drive and cable driven centrifugal governors. Other governors are available with a mercury arc switch. Pierce Governor Co.

23—PHOTOELECTRIC COUNTER

Is completely packaged and engineered for easy installation

Counter Set P-1 is described as an accurate, low cost, general purpose counter. It consists of photoelectric control, light source and electric counter. The only equipment located at the point of count is the control and light source. One or more counters (containing the counter face and reset knob) may be placed at any convenient locations and wired to the control.

The set is designed particularly for counting production moving along conveyor systems or feeding from the output of automatic machines. The light source supplied has an adjustable lens system for narrowing down the light beam for counting small objects.

The control has a line cord with a male plug connection which fits any 115-v 60 cycle a-c standard lighting outlet. This supplies power for the light source and counter, which in turn have cables and plugs for plug-in connection to the control. Set makes up to 600 counts per min; its operating range is 6 ft between photoelectric unit and light source. Special light sources available for longer range. Photoswitch Inc.

24—LINING MATERIAL

Is corrosion preventive for condensate tanks, return system receivers

Now available as a lining material on manufacturer's condensate tanks and return system receivers is Chromasoid, described as a successful formulation of a furfuryl alcohol resin, chemically inert as far as known. It is said that no chemical reagent has been found that will attack this material once it has completely set. Black in color, Chromasoid dries to a hard glossy finish with the appearance of porcelain.

However, it has sufficient flexibility when used with a special primer to maintain adhesion to metal surfaces, manufacturer points out, even under severe thermal shock. It is said to impart no color, taste or odor to water held in storage and to be unaffected by temperatures up to 500 F. Receivers lined with it will carry a long guarantee. Fred H. Schaub Engineering Co.

control SLIME and ALGAE... SANTOBRITE

Santobrite—Monsanto's Sodium Pentachlorophenate, Technical—offers you these advantages for elimination of slime and algae in cooling water systems:

1. Maximum control of algae and slime-forming organisms.
2. Requires no special feed equipment (merely add to circulating water at any convenient location).
3. Compatible with other chemical treatments given cooling water.
4. Non-corrosive to metals.
5. Easy to apply in powder, briquettes or new dustless pellet form (for those who find Santobrite dust bothersome).
6. Readily available at reasonable cost.

Santobrite provides an economical means of maintaining peak efficiency in your cooling operations... For more detailed information, send for a copy of Monsanto Technical Bulletin O-15. MONSANTO CHEMICAL COMPANY, Desk F, Organic Chemicals Division, 1765 South Second Street, St. Louis 4, Mo.

SANTOSITE...
Controls oxygen corrosion in boiler systems

By removing all traces of residual oxygen, Santosite makes possible economical control of oxygen corrosion in boiler tubes and other steam generating equipment. For detailed information on the Santosite treatment, ask for a copy of Monsanto Technical Bulletin O-26.

Santobrite, Santosite: Reg. U. S. Pat. Off.

MONSANTO
CHEMICALS AND PLASTICS

MONSANTO CHEMICAL COMPANY
Desk F, Organic Chemicals Division
1765 South Second Street, St. Louis 4, Missouri

Please send me: ( ) Technical Bulletin O-15 on Santobrite; ( ) Technical Bulletin O-26 on Santosite for boiler feed water.

Name_____ Title_____

Company_____

Address_____

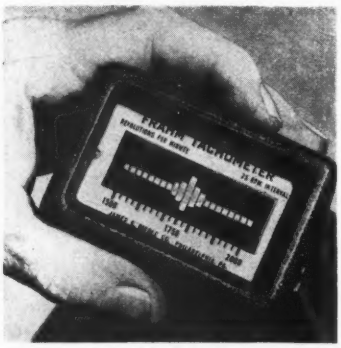
City_____ State_____

SERVING INDUSTRY...WHICH SERVES MANKIND

25—MINIATURE TACHOMETER

For making speed checks quickly by touch or permanent mounting

This low cost Frahm Resonant Reed Tachometer requires no contact with rotating element and imposes no load on the machine under test, manufac-



turer states, adding that it cannot be injured by over-speeding and requires no maintenance. It measures rpm and vpm and is available in ranges between 1000 and 13,000 rpm. Cases are available to accommodate one or three instruments; 60 and 90 deg brackets for mounting are also available. James G. Biddle Co.

26—PORTABLE TESTING KIT

For indicating the acidity of transformer and turbine oils

An important feautre of this kit is that the neutralizing KOH is in single measured doses, in sealed ampoules, so the

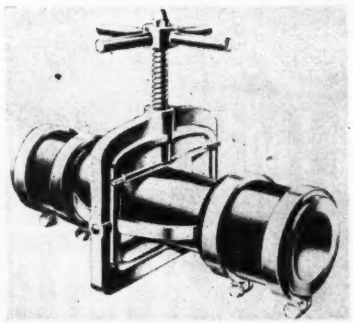
KOH does not lose strength from contact with the atmosphere. Ampoules are supplied with a neutralization value of 0.3, 0.6 and 1.5 mg of KOH per gram of oil.

Kit includes four glass cylinders, two pints of a neutral solution of water-alcohol-pink indicator, 20 ampoules of the KOH, and files for opening the ampoules, and simple instructions. Boxed in a mahogany case. Priced at $25.00 The Gerin Corp.

27—PINCH VALVES

Are designed for full pipe capacity and bubble tightness

Flex-Valves consist of the slip on, Type 7100, in sizes ½ to 2½ in., which mounts



over ends of the pipe; the flanged end, Type 7200, in sizes 1 to 12 in., and the diaphragm motor type in sizes 1 to 10 in. — both operating air-to-open and operating air-to-close. These valves are said to be particularly applicable in the paper, pulp, coal, sand, chemical, sewage, sanitation, foods, mining and clay industries. They are described as practically indestructible on abrasives or corrosives not affecting rubber, Neoprene, Buna N and Butyl. Flexible Valve Corp.

28—PRECISION AIR METER

For measuring velocities in ranges of 0 to 400 and 400 to 6000 fpm

This instrument is applicable to measurement of air velocities in ducts, flow in air and gas lines, surveys of heating and air conditioning systems and process control. Its operation is based on a combination of the hot wire and thermopile principles. This arrangement is said to increase the accuracy by eliminating errors due to air temperature variations. The output is suitable for remote indication and operating a standard strip or circular chart electrical recording instrument.

The photograph shows complete instrument with tee section pickup probe. The indicator is housed in a sturdy cast aluminum case with provisions for probe and extension cable. Operates from 110 a-c power and is complete with voltage regulated power supply. Hastings Instrument Co., Inc.

29—POCKET TYPE AMMETER

Is developed for measuring current without interrupting service

A rugged pocket instrument for electricians, maintenance men, and motor repair shop use, the Amprobe is only 7⅛ in. long by 2⅛ in. wide by 1⅛ in. thick, and weighs 12 oz. A plastic finger trigger opens the transformer probes and clamps around the conductor thus measuring current in circuit.

Available in two models, each with seven ranges. Model A-5 is 6.5/13/26/65/130 amp and 130/260 v. Model A-6 is 10/25/50/198/250 amp and 150/600 v.

The case and scale window are lucite plastic. Scale length is 2.47 in. The Amprobe is completely insulated, according to manufacturer.

Jaws are shaped to get into tight spots, behind switch panels, motors. Instrument will handle conductors up to 1⅛ in. dia. Designed for one hand operation. Accuracy of meter is given as ± 3 per cent of full scale. Pyramid Instrument Co.

30—PLASTIC INSULATING FILM

For electrical use; goes on coils like tape, is then heat treated

Scotch-Weld electrical insulating film No. 70, when applied and heat treated, bonds itself into a unified layer of insulation. It is said to have high dielectric strength and good resistance to heat, moisture, oil and most solvents.

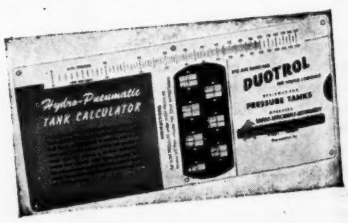
Made entirely of synthetic resins, the film comes in 60-yd rolls in widths up to 42 in. and in thicknesses of 2, 4, 6 and 8 mils. Minnesota Mining & Mfg Co.

31—TANK CALCULATOR

For finding the best high water level in pressure tanks

Fast, accurate determination of best high water level under all operating conditions is claimed possible with the Autocon Hydro-Pneumatic Tank Calculator. This calculator (based on the Boyles law) is designed to tell the best air-water ratio, most efficient pressure drop differential, exact amount withdrawn on any pressure drop, and resultant reserve or residual.

According to manufacturer, this information put to work can save power and reduce maintenance costs by anticipating pump operations per hour at any demand rate, thus determining what air-water ratio and pressure differential will provide the most efficient operation. All mounting scales are on side of the calculator, and instructions are included. Its size is 9 by 4 in; price $1.00 Automatic Control Co.



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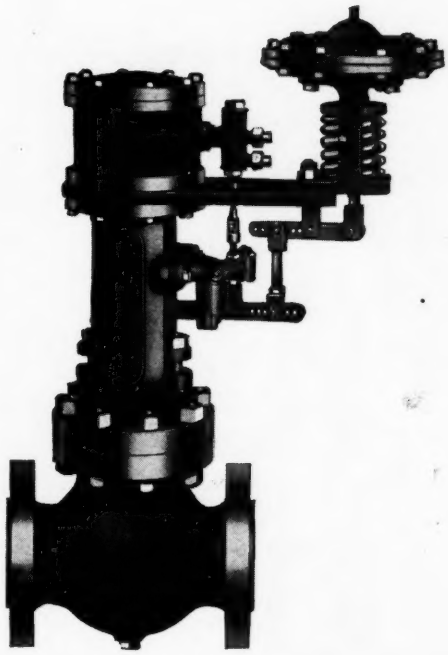
For more exacting

PRESSURE REDUCING JOBS



Type R-DSLH, relay-operated for remote control
Below: Type DBI is direct-operated and self-contained

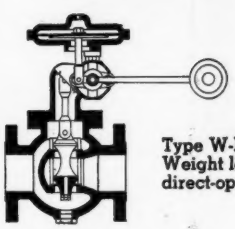
COPES Pressure Reducing Valves are designed for tough jobs demanding greater accuracy and dependability than can be obtained with ordinary stock valves. They are built to give as good results under emergency conditions as in normal service—to avoid objectionable vibration, noise and wear. Each is engineered for the individual installation, to assure close pressure control and long service life with minimum maintenance.

The COPES line is complete, covering a controlled pressure range from 27 inches of mercury vacuum to 600 psig. Valves are direct- or relay-operated, self-contained or actuated by a master control—as dictated by the individual operating conditions. Write for Bulletin 477.

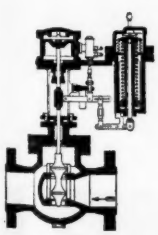
ENGINEERED BY THE MAKERS OF COPES

FLOWMATIC

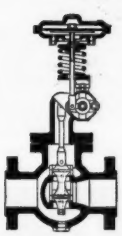
NORTHERN EQUIPMENT COMPANY
992 GROVE DRIVE, ERIE, PA.
BRANCH PLANTS: Canada, England, France and Austria
Representatives Everywhere



Type W-DBI. Weight loaded, direct-operated



Type 3-SH-2C for heavy duty. Relay-operated, self-contained



Type R-DBI for remote control from master

COPES

Headquarters for . . .

Boiler Feed Water Control . . . Excess or Constant Pressure Control, Steam or Water . . . Liquid Level Control . . . Balanced Valves . . . Desuperheaters . . . Boiler Steam Temperature Control . . . Hi-Low Water Alarms.

SEATLESS MEANS ECONOMY

IN BOILER BLOW-DOWN SERVICE

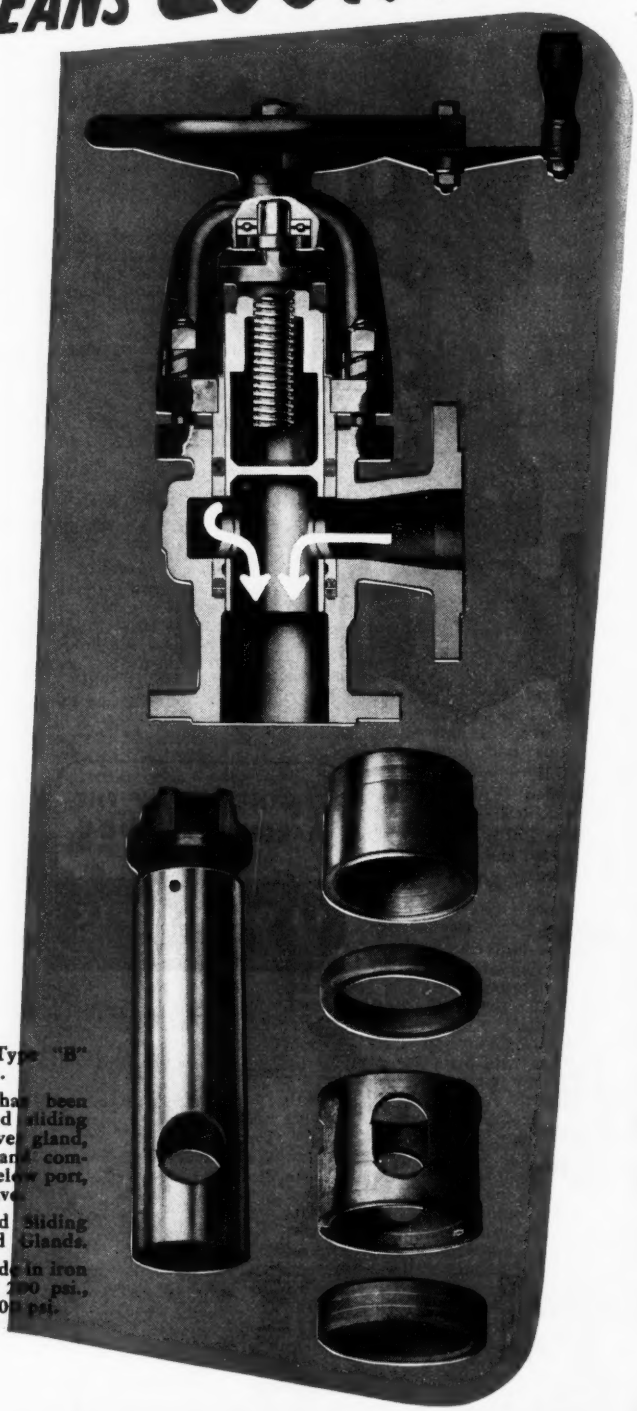
Because they eliminate the commonest source of trouble and expense in ordinary blow-off valve service, Yarway *Seatless* Blow-Off Valves mean real economy to boiler plant operators. *Yarways have no seat to score, wear, clog and leak.* Lubrication is usually the only maintenance they require.

Yarway introduced the seatless principle with the balanced sliding plunger many years ago . . . has constantly improved and adapted it to meet modern service requirements. Mechanical and metallurgical research in Yarway's own Steam Laboratory anticipates changing conditions . . . keeps Yarway valve design ahead.

There is a Yarway Blow-Off Valve for every pressure.

SEND FOR FREE BLOW-OFF VALVE BOOKLET. PLEASE INDICATE THE PRESSURE OF YOUR BOILERS.

YARNALL-WARING COMPANY
114 Mermaid Avenue, Philadelphia 18, Pa.



(*Above*)—Cross section of Type "B" Seatless Angle Valve, flanged.

OPERATION: After valve has been closed, shoulder on balanced sliding plunger contacts upper follower gland, forcing it down into body and compressing packing above and below port, making an absolutely tight valve.

(*Below*)—Type "B" Balanced Sliding Plunger, Packing Rings and Glands.

Yarway Type "B" Valve is made in iron for blow-off pressures up to 200 psi., and in steel for pressures to 400 psi.

YARWAY BLOW-OFF VALVES

LETTERS TO THE EDITORS

ADDITIVES

This all started in the February 1949 issue with a general discussion of fuel oil additives, in which there is now so much interest throughout the whole power field. The article came from Paul F. Schmidt, chemist with Allied Oil Co., Inc. and it certainly stirred up some very practical discussion among readers, which is still going on.

In the April issue, Clarence W. Hope asked some specific questions: 1—What is sludge? 2—How can you tell what effect treatment has on sludge, if there is no sludge available? 3—If no water is present, will sludge form? 4—How can operator tell if treatment is working? 5—How can he prove it is eliminating water? 6—Are there simple tests to prove the additive is good?

In the June issue, Mr. Schmidt presented more data, in answer to a letter from A. A. Berk, which covered some of these points. Now we have some very definite comments, below, from one who has had satisfactory experience with additives.

This is particularly welcome because it comes from an operating man and is exactly the sort of practical comment needed to dispel many of the mysteries that apparently have been injected into this subject. Moreover, he offers to tell you the name of the additive he uses if you will ask for it. Send your request through the Editors.

I HAVE READ with great interest Mr. Hope's letter in the April issue on fuel oil additives. I am no chemist; just a power engineer and have had experience with additives for the past nine years; therefore, I will try to answer the questions Mr. Hope asks:

1. Sludge is a mixture of precipitated organic matter, carbon and inorganic matter. Some sludge is the result of mixing and blending oils. It looks exactly like the muck in the bottom of Mr. Hope's tank.

2. Mr. Hope should know the additive he used had no effect; there was plenty of sludge.

3. No sludge is part of the No. 6 fuel oil if it is kept in suspension; it has definitely the specified Btu value. Under certain conditions, water will be the cause of precipitation.

4. Freedom of clogged strainers, good fuel oil and clean systems.

5. Rather than use the word "eliminate", it is better to consider the water combined with oil in a state of emulsion.

6. I know of no simple test.

We have two 30,000-gal tanks underground and consume 60,000 barrels of No. 6 oil per year. Each tank has two suction lines; the high suction is 6 in. from the bottom and the low suction is 2½ in. from the bottom. We have not as yet used the high suction.

Strainers are cleaned twice a week. Burners are changed once every 24 hr. Our fuel oil heaters have never been cleaned; and, from all meter readings, they do not use any more steam now than they did 9 years ago.

When we started to use additives, there were few on the market; today I have many salesmen trying to change me over, but my answer is that the product we have been using is doing the job, so I see no reason for changing.

I have refrained from mentioning the name of the product we use because of our company policy, but will gladly supply the name to anyone requesting it.

New Jersey — STEVEN SENKO

FROZEN COAL

YOU HAVE had two articles on this subject recently that merit some comment. Some months ago (September, 1948 issue) you had an article on the thawing of coal in cars. One method, used in at least two places, was not mentioned. This is the so-called "lance method". A "lance" of 1-in. or 1¼-in. pipe is pointed slightly at one end and connected to a steam header (125 psi) by a stop cock and steam hose. A workman or two mount the car and start steam through the lance, working it down into the coal. This method is used only with smaller sizes of anthracite—chestnut and smaller where the granular nature facilitates penetration of the lance.

A later article (May, 1949 issue) dealt with corrosion due to use of calcium chloride to prevent freezing. I have had contact with only one operation of this sort and had not heard of serious corrosion. However, it may be that the peculiar method of operation may have affected this.

The New York, Ontario and Western Railway hauls anthracite from the fields near Scranton, Penna. to New York harbor. On the way it is dumped, piled and treated at Middletown, N. Y., 80 miles from New York City. Later it is reloaded and hauled to the railroad pier at Weehawken, N. J., where it is dumped into barges for transportation to yards in the city. This serves not only for a treating operation but for stock piling as well.

As to corrosion, my employer, the Pennsylvania Railroad, experimented for a short period with the use of sea water for drenching the coal (summer use) before dumping at the South Amboy (New York harbor) facilities. A few months use showed that corrosion of the dumper aprons, chutes, and other such equipment, was so serious that purchase of fresh water would be more economical.

During the war, it fell to my lot to investigate thawing and dumping facilities of all coal carrying roads terminating at New York Harbor, in view of anticipated increased consumption because of power demands. Most facilities used an oven-like building, heating the air in a variety of manners.

The two methods mentioned above were exceptions. Only on major facility, a trestle with bins and chutes, operated by the Berwind-White Coal Co. had no thawing facilities. The lance method was not liked by those responsible for operation, for the labor cost was high and steam demand sometimes would out-run boiler capacity. It was used only to take care of "peak load".

Philadelphia, Pa. — R. E. BUFFINGTON

Editor's Note:—Even though this summer has been unusually hot, we might get another severe winter. Consult the weather prophets. Perhaps it's time to give a little thought to this again. Don't get caught again with the trousers at low elevation.

GROUNDING NEUTRALS

WHILE SOLID grounding of generator neutrals may look very good practice to some people, it actually can be very troublesome. We had a case recently of two 2000-kw generators connected in Y for 4180v, which were supposed to have the neutrals grounded through resistors. The generators were ready to run and the resistors had not arrived so they simply grounded solid both generators.

Since the load was only 1800 kw, only one machine was run at a time for several weeks and it ran perfectly. However, when the load reached 2000 kw and it was necessary to synchronize both generators, it was impossible to obtain stable operation and even division of load and the ground relay kicked out one breaker all the time. Removing the ground connection in one of the generators solved the problem and still kept the system neutral grounded.

This condition was created by the two generators generating different harmonic voltages, which caused a circulating harmonic current. The magnitude of this current is equal to the resultant harmonic voltage divided by the impedance of the harmonic frequency. In paralleling alternators, they must not only have same voltage and frequency rating, but also approximately the same wave form. If the wave form is not the same, there will be a triple frequency current in each phase besides the normal current, and these

(Continued on page 81)

A POWER GENERATION FEATURE

Waterside Completes Its Topping Program

Part II. In the May issue, R. T. Roberts[1] described the topping program at Waterside Station of the Consolidated Edison Company of New York so far as the boiler room was concerned. Now, in this second article, Mr. Knecht takes up the turbine-generator part of the program. This involved the installation of two high-pressure and two low-pressure units. The engineering on this part of the program is especially interesting because of the space restriction which prevailed at this famous station

By **H. KNECHT**, Mechanical Plant Engineer,
Consolidated Edison Company of New York

FIFTY YEARS AGO Waterside Station No. 1 was located in mid-Manhattan because of the expectation that the center of New York City's load growth would be in this area. This expectation has materialized and accounts for the comprehensive modernization program initiated and carried through in Waterside Station No. 2 and now nearing completion in Waterside Station No. 1.

Waterside Station No. 1 was formally started up in 1901 and the original plan called for the installation of 16 - 3500 kw vertical engine-driven generators. However, only 11 of these machines were actually installed, 5-5000 kw vertical turbo-generator units being added in 1904. Records indicate that although the engines were more efficient, the steam turbines were chosen because fewer operators were required and more kilowatt capacity could be installed in a given space. The 54 original boilers were hand-fired.

Many changes were made in the turbine room equipment from 1901 until the start of the new program in 1945, the installed capacity rising from 38,500 kw in 1901 to 200,000 kw.

The only change in the boilers in that period was the addition of underfeed stokers and superheaters.

In general, the program of modernization for Waterside Station No. 1 covers:

1—Removal of all boilers
2—Removal of 3 - 20,000 kw vertical turbine generators
3—Installation of 2 high pressure boilers, 2 high pressure turbine generators and 2 low pressure condensing turbine generators
4—Construction of 2 electrical galleries for the expanding 60 cycle load
5—Ultimate rewinding of 2 of the existing 35,000 kw 25 cycle turbine generators for 40,000 kw and 60 cycle
6—Interconnecting Waterside Nos. 1 and 2 by steam, condensate and make-up so that the two stations can operate substantially as one.

The details of the new boiler installation were described in an article by R. T. Roberts in the May issue.[1]

The two high pressure units, manufactured by the Westinghouse Electric Corp., are each rated at

[1] Waterside Completes Its Topping Program. By R. T. Roberts, May 1949, page 62.

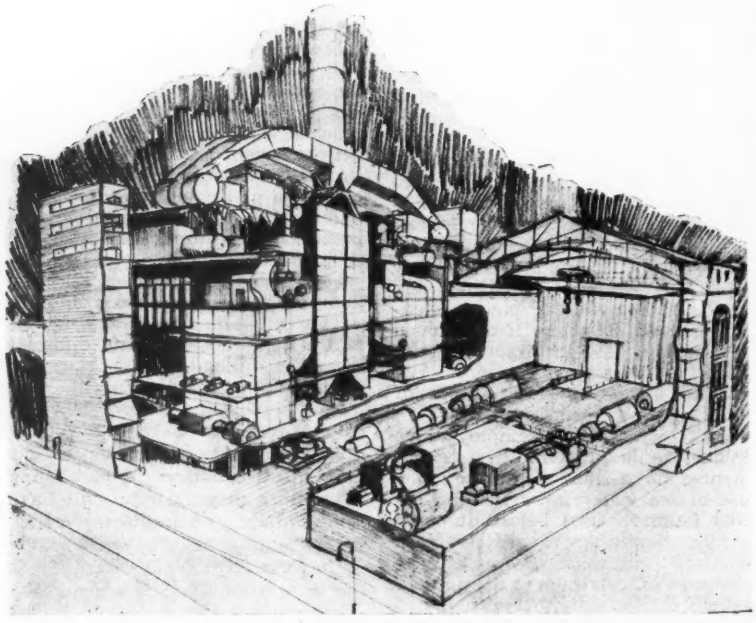


Fig. 1. A perspective sketch showing the general arrangement of the new equipment at Waterside

50,000 kw at 0.8 pf, 14,400 v, 60 cycle, 3 phase and operate at 3600 rpm.

Each turbine is a single cylinder impulse reaction type having a 2-row impulse stage followed by 18 reaction stages. The bleed point is after the 12th stage. Seven control valves are provided, five admitting steam to the different sections of the impulse stage nozzles and two admitting steam directly from the impulse chamber to the first reaction chamber or the 6th stage.

The design steam conditions are 1600 psig, 950 F at the throttle, 400 psig at the bleed point and 200 psig, 485 F at the exhaust.

The generator is hydrogen cooled with integral fans and internal gas coolers and is capable of delivering rated kva output at all terminal voltages from 13,200 to 15,100 v. Excitation is provided by a direct connected exciter and pilot exciter. The exciter is rated at 185 kw, 250 volts dc, the pilot exciter at 2.5 kw, 250 volts, dc.

Provision has been made to operate at hydrogen pressure from ½ psig to 15 psig.

Control and Oil System

The control system, entirely hydraulic, uses part of the main oil pump discharge as the actuating medium. The main oil pump is of the centrifugal type, mounted on the main turbine shaft.

A vertical steam turbine driven centrifugal auxiliary oil pump is provided to furnish oil when starting, stopping or in an emergency. In addition, a vertical motor-driven turning gear oil pump is supplied to not only furnish bearing oil normally when the turning gear is in operation, but also to cut in automatically upon failure of the bearing oil supply.

Low Pressure Turbine-Generators

The two low pressure turbine generators, manufactured by the General Electric Co, are each rated at 60,000 kw, 0.8 pf, 75,000 kva, 3 phase, 60 cycle, 14,400 v, 1800 rpm.

Each turbine is a single flow condensing machine. The high pressure shell incorporating the control valve casings is bolted to the intermediate shell which, in turn, is bolted to the exhaust hood. The unit has 14 stages, with connections at the 9th and 11th stages for induction and extraction, respectively. Surplus 5 psig steam enters the induction point and 5 psia steam is extracted from the 11th stage for feedwater heating in direct contact heaters. These direct contact heaters are mounted on top of the electric generators due to space restrictions.

The turbine has five control valves, three of which admit steam to different sections of the first stage nozzle, while the remaining two bypass steam to the first stage shell. Two quick closing stop valves are provided at the steam inlet of each machine.

The design steam conditions are 185 psig, 500 F and 1½ in. Hg back pressure.

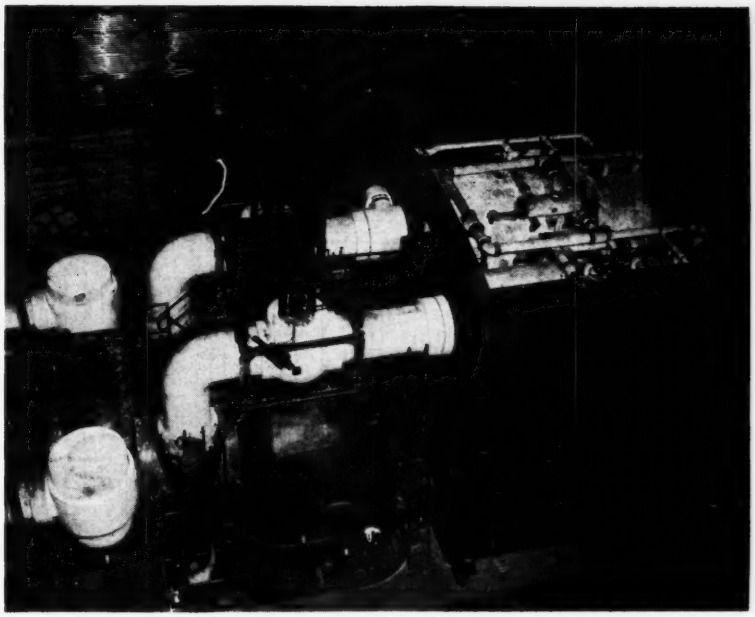


Fig. 2. Because of space restrictions it was necessary to mount the direct contact bleeder heaters on top of the electric generators of the low pressure units

The generator is hydrogen cooled with integral fans and internal gas coolers, designed to operate at hydrogen gas pressures from 5 to 15 psig. Excitation is provided by a direct connected main and pilot exciter, the former rated at 275 kw, 250 v and the latter at 4 kw, 250 v.

Control System

The main operating governor is of the centrifugal type driven by the turbine shaft, through a worm gear.

Each of the two 30 in. diameter extraction lines from the 11th stage is provided with a positive sealing swing check valve to prevent back flow from the direct contact heaters. The positive sealing device is held inoperative against spring action by air pistons while the turbine is in service. The air to the piston passes through an air-oil relay valve so that when the machine trips out the decreased oil pressure cuts off the air and the check valve closes by spring action.

The excess auxiliary exhaust 5 psig steam which enters the 9th stage induction point passes through the 24 in. control valve and 24 in. quick closing stop valve in series. The latter valve is held open by turbine oil pressure and closes on tripping out of the main turbine. The other valve which is set to maintain an upstream pressure of 5 psig is air operated and is also designed to close on low oil pressure when the main unit trips out.

Oil System

Each unit is provided with two vertical motor-driven main oil pumps and one vertical turbine-driven auxiliary oil pump. A vertical motor-driven turning gear oil pump is also provided to supply bearing oil during turning gear operation and to cut in automatically on bearing oil failure.

Turbine Supervision Instruments

Each of the four turbine-generator units are equipped with a vibration recorder, an eccentricity recorder, a speed recorder, a multipoint bearing temperature recorder, and an expansion indicator for the cylinder and spindle. Thrust bearing alarms are also provided.

Condensers

The two condensers were furnished by the Worthington Pump and Machinery Company and are of the horizontal 2-pass type with vertically divided water boxes. Each has a surface of 74,500 sq ft. The condenser is guaranteed to condense 570,000 lb of steam per hour and maintain an absolute pressure at the throat of 1.24 in. of Hg when supplied with 52,600 gpm of water at temperature of 57 F. This performance is based on 75 per cent cleanliness factor. In addition, the condenser is designed to heat and deaerate 1,095,000 lb per hr of make-up water under normal operation and 2,190,000 lb per hr in an emergency. Tubes are aluminum bronze ⅞ in. OD No. 18 Bwg, 30 ft overall in length and 10,945 in number per condenser. The inlet ends of all tubes have been painted with Debecote for protection.

Each condenser is supplied by two 36 in. vertical single stage mixed flow circulating water pumps each rated at 26,300 gpm, 28.32 TDH at 500 rpm, and rubber-seated butterfly valves are provided in the piping to isolate each half of the condenser.

Three motor-driven hotwell pumps

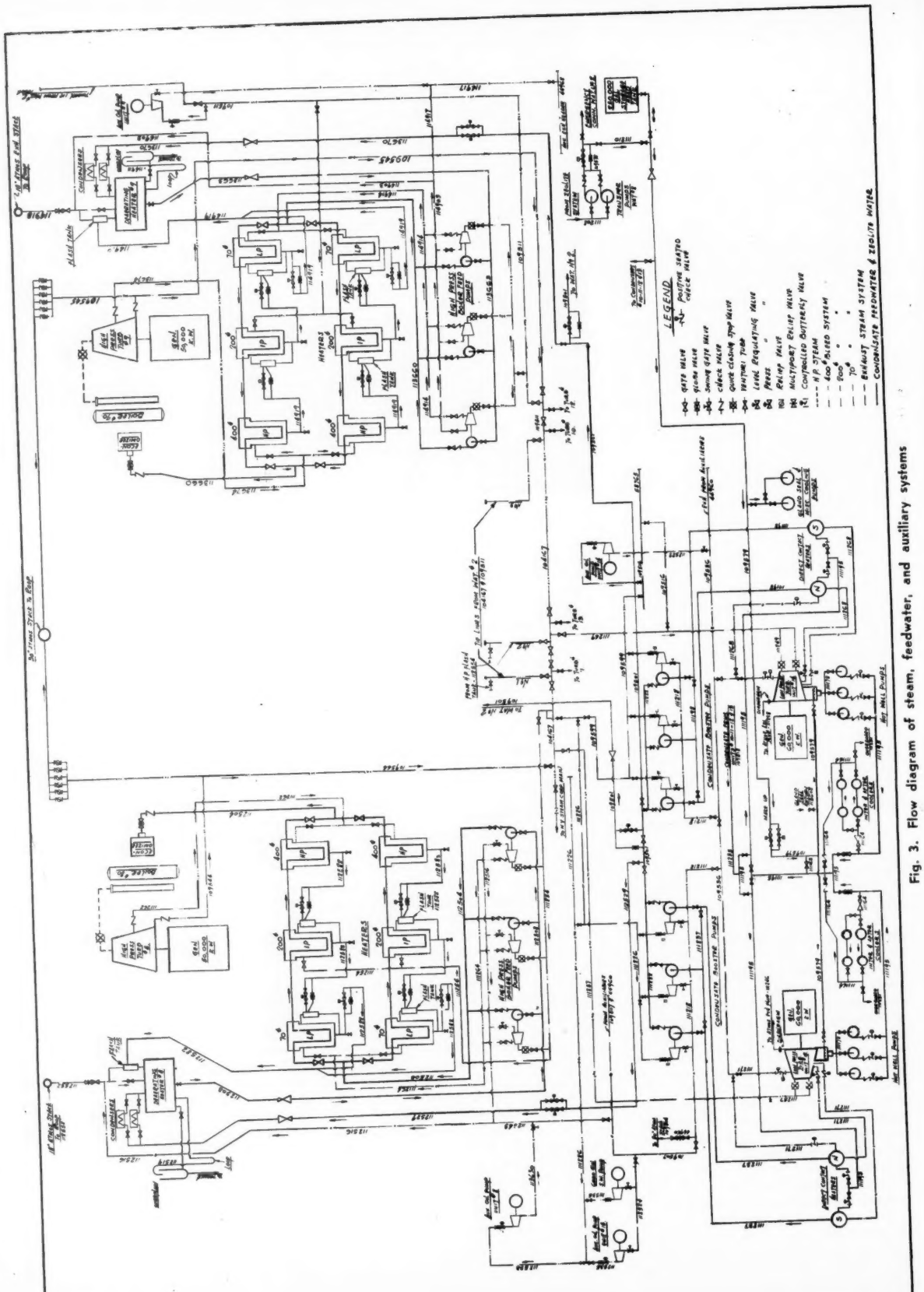


Fig. 3. Flow diagram of steam, feedwater, and auxiliary systems

connected in parallel have been provided for each condenser, two running and one spare. Each pump is rated at a capacity of 2,000 gpm, with a TDH of 123 ft at 880 rpm. Butterfly type control valves have been installed on the discharge side of these pumps to maintain constant hotwell level.

Condensate System

As shown in the flow diagram, a portion of the condensate leaving the hotwell pumps is by-passed through the steam jet air ejector and the combined flows from both new low pressure units join in a common header system. To this stream is added the condensate from

Fig. 3. Flow diagram of steam, feedwater, and auxiliary systems

LIST OF TURBINE PLANT EQUIPMENT

WATERSIDE NO. 1
UNITS 8 & 9 and UNITS 14 & 15

UNITS 8 & 9—Units are essentially duplicate in all respects. The following describes either.

Turbines—Westinghouse Electric Corp., 50,000 kw at 0.8 pf, 3600 rpm, single cylinder impulse reaction type, having one 2-row impulse stage followed by eighteen (18) reaction stages. Bleed point after 12th reaction stage. Normal steam at throttle is 1600 psig and 950 F, exhausting at 200 psi, 485 F with 400 psi at bleed point.

Generator—Westinghouse 50,000 kw, 0.8 pf, 62,500 kva, 3 phase, 60 cycle, 14,400 v, 360 rpm, hydrogen-cooled units, 60/85 C, 250 v, field with direct connected 185 kw 250 v main exciter and 2.5 kw 250 v pilot exciter.

Closed Feedwater Heaters—(2) Sets each of 3 American Locomotive Vertical, 2-pass, U-tube removable shell type heaters with integral hot wells. Each set consists of one 2100 sq ft of effective surface 70 psig low pressure heater; one 2118 sq ft 195 psig intermediate pressure heater; and one 2277 sq ft 390 psig high pressure heater. The high pressure heaters are provided with a desuperheating section consisting of a separate chamber in the steam space of the shell at the end of the last pass of water tubes. The tubes are 80-20 cupro-nickel, ¾ in. OD, 12 BWG.

Deaerating Heater—Elliott Co. direct-contact tray-type deaerating heater with 2 vent condensers rated at 1,100,000 lb per hr, 18 psia with 1000 cu ft of water storage. Dissolved oxygen content not to exceed 0.005 cc per liter.

Boiler Feed Pumps—(3) Byron-Jackson, 8 stage, outer barrel and inner volute, horizontal split case type. Normal full load 470,000 lb per hr, 1800 psig, 222 F, 4475 rpm, 1300 bhp. Direct connected to non-condensing controlled extraction type G.E. Type DORV-725 turbine having 7 impulse stages with 3 above bleed point and 4 below. Rated at 1300 hp, 4475 rpm, with 185 psi, 485 F steam and 5 psig exhaust. Extraction pressure 90 psia. Also equipped with G.E. motor driven turning gear.

Hydrogen Cooling Water Pump—Gardner Denver Co. centrifugal pumps rated at 1000 gpm at 60 ft TDH driven by G.E. Co. 20 hp, 1200 rpm, 208 v, 60 cycles, 3 phase motor.

Acid Washing Pump—Duriron Co. pump of "Chlorimet No. 3" rated at 475 gpm, 85 ft TDH, driven by 25 hp, 1800 rpm, 440 v, 3 phase, 60 cycle, G.E. motor.

UNITS 14 & 15—Units are essentially ing describes either:

Turbine—General Electric Co. 60,000 kw at 0.8 pf, 1800 rpm, single flow condensing machine. 14 stage unit, with 5 psig induction connection at 9th stage and 5 psia extraction connection at 11th stage. Normal steam conditions are 185 psig 500 F and 1½ in. Hg. back pressure.

Generator—General Electric 60,000 kw, 0.8 pf, 75,000 kva, 3 phase, 60 cycle, 14,400 v, 1800 rpm, hydrogen-cooled unit. Excitation provided by main and pilot exciters mounted in common housing on end of generator rotor. Main exciter is rated at 275 kw, 1800 rpm, 250 v. Pilot exciter is rated at 4 kw, 1800 rpm, 250 v.

Condenser—Worthington Pump & Machinery Corp. horizontal two pass type with vertically divided water box. Nominal capacity is 570,000 lb of steam per hr with 1.24 in. of Hg at throat when circulating 52,600 gpm of water at inlet temperature of 57 F. Preheating and deaerating hotwell of 2400 gal capacity. The condenser has 74,500 sq ft of surface and contains 10,945, ⅞ in. OD, No. 18 BWG. 30 ft, 0 in. long aluminum bronze tubes. Two twin element two-stage air ejectors are provided each element having capacity of 12 cfm at 1.0 in. HG absolute. In addition, there are 3 single stage non-condensing jets, two for priming steam side and one for water circuits. In addition to condensing service, the condenser will heat and deaerate a maximum of 2,190,000 lb per hr of makeup.

Direct Contact Heaters—(2) Worthington Pump and Machinery Corporation Horizontal Non-Deaerating Jet Heaters with twin single stage steam jet air ejectors. Rated to deliver 1,000,000 lb per hr of water, at a temperature within 1.5 of saturated temperature of heating steam at pressures of 4 psia to 22 psia with entering water at 65 F. Maximum capacity is 1,250,000 lb per hr effluent. One of each pair is provided to employ 5 psig steam when turbine is out of service.

Circulating Water Pumps—(2) 36 in. Worthington Pump and Machinery Corp. "Hiflo" vertical, single stage, mixed flow pumps of the interior pull-out type. One pump is piped to one side of condenser. Pumps are rated at 26,300 gpm, 28.32 TDH at 500 rpm and are direct connected to Allis Chalmers 250 hp, 440 v, 60 cycle, 3 phase, totally enclosed, fan cooled motors.

Hotwell Pumps—(3) Ingersoll-Rand No. 18 APHC—3 stage, vertical turbine type Hotwell pumps rated at 2000 gpm, 123 ft TDH at 880 rpm, driven by direct connected G.E. 100 hp, 440 v, 60 cycle, 3 phase motor.

Condensate Booster Pumps—(3) Ingersoll-Rand, Type 8 ALV single stage double suction centrifugal pumps, 2500 gpm, 199 feet TDH at 2000 rpm driven by DeLaval Type TCL Turbines rated at 150 hp, 2000 rpm. Steam at 185 psig, 485 F TT and 7 psig back pressure.

Hydrogen Cooling Water Pump—DeLaval Type 10 M-P 4/3 Centrifugal Pumps. Rated at 400 gpm, 75 ft head at 3600 rpm driven by 10 hp, 208 v, 3 phase, 60 cycle motor.

Zeolite Water Transfer Pump—Ingersoll-Rand, Type 10 AFV, single stage, double suction, horizontally split centrifugal pump, 4500 gpm, 125 ft TDH at 1775 rpm direct connected to G.E. Company, 200 hp, 1800 rpm, 2300 v, 3 phase, 60 cycle motor.

In addition the following equipment was installed for general service at the same time

Turbine Gland Seal Pump—(1) DeLaval all bronze single stage double suction gland seal pump. Rated at 700 gpm with 10 ft positive suction head and TDH of 100 ft. Direct connected to a GE 25 hp, 208 v, 3 phase, 60 cycle. 1750 rpm motor.

Salt Water Cooling Pumps—(4) Warren type 10-DL-16 single stage, double suction motor driven pumps rated at 2500 gpm, 1150 rpm, 100 ft, TDH, with 22 ft suction lift. Motors are G.E. Co. 100 hp, 1200 rpm, 3 phase, 440 v.

(1) Gardner Denver Type G-12 in. single stage, double suction pump rated at 6000 gpm, 100 ft TDH with 22 ft suction lift at 1180 rpm. Drive is Worthington Turbine Type S3R, 188 hp, 1180 rpm, 175 psig, 485 F, total temperature steam and 7 psig back pressure. (For emergency use as replacements of the above 4 pumps.)

(2) Gardner Denver Type GA, single stage, double suction, centrifugal pumps rated at 500 gpm, 300 ft TDH at 3500 rpm, driven by G.E. Co. 60 hp, 3 phase, 440 v, 3600 rpm motors.

City Water Pump No. 3—(1) Ingersoll-Rand Type AFVS, single stage, double suction, centrifugal pump, rated at 3100 gpm, 1775 rpm, 100 ft TDH driven by 100 hp, 3 phase, 208 v, 1775 rpm, G.E. Motor.

Air Compressor No. 8—(1) Chicago Pneumatic Tool Co. motor driven air compressor, duplex, 2 stage has capacity of 913 cfm at 100 psi and 907 cfm at 125 psi complete with after cooler and receiver.

Hotwell Pumps for Nos. 10, 11, 12 and 13—(4) Ingersoll-Rand Type 5 DHW, 2 stage pumps rated at 1000 gpm, 152 ft head at 1170 rpm, driven by 60 hp, 440 v, 3 phase, 60 cycle, totally enclosed fan-cooled, G.E. Motor.

Fig. 4. A general view of the Waterside turbine room during construction

the existing low pressure units Nos. 10, 11, 12 and 13. At this point the total flow of condensate is directed in four equal streams to the four direct contact heaters. Booster pumps take the condensate from the direct contact heaters and pump it to the main condensate header which supplies the deaerating heaters Nos. 8 and 9 in Waterside No. 1 preferentially, the surplus being returned to the deaerators in Waterside No. 2 over a 12 in. and a 16 in. line.

The new deaerators Nos. 8 and 9 are of the horizontal tray type and are each rated to deliver 1,100,000 lb per hr of water having an O_2 content not exceeding 0.005 cc per liter at a temperature corresponding to a heating steam pressure of 18 psia when the entering water is 150 F.

From each deaerator the condensate is carried to the suction of the three 8-stage turbine driven boiler feed pumps, arranged so that two carry full load and one is spare. The pumps are of the outer barrel, inner volute casing type designed to pump, under normal full load, 470,000 lb per hr of water at a TDH of 1800 psig and speed of 4475 rpm. The turbine drive is a direct connected non-condensing controlled extraction type machine having 7 impulse stages and a normal rating of 1300 hp. The steam conditions are 185 psig, 485 F inlet steam, 75 psig extraction and 5 psig exhaust. This turbine is equipped with a turning gear so that the spindle may be rotated at low speed and kept straight when the pump is acting as a spare.

The boiler feed pumps of each HP unit discharge into a common header and then through two parallel rows of closed feedwater heaters. Each row consists of a low pressure heater using 70 psig extraction steam from the boiler feed pump drives, a 200 psig heater using high pressure turbine exhaust steam, and a 400 psig heater using bleed steam from the high pressure turbine. Under normal conditions the temperature of water leaving the last heater will be 445 F.

200 lb Steam System

The 200 lb exhaust steam lines from the high pressure topping units Nos. 8 and 9 connect into a new 30 in. header which supplies steam to the present low pressure condensing units Nos. 10, 11, 12 and 13, as well as the new units Nos. 14 and 15. A 20 in. connection with a pressure reducing valve and desuperheater is also taken off this header for supplying the New York Steam Corporation mains. A comparison of the new and old header systems indicates typically the efforts made toward general simplification in the design of this project.

Make-Up

The make-up for both Waterside No. 1 and Waterside No. 2 is treated at the Zeolite plant in Waterside No. 2. To insure approximately the same percentage of make-up entering all the boilers in both stations, regardless of loading, a fixed quantity (approximately 300,000 lb per hr) is directed to Waterside No. 2 condensers. The rest of the make-up (up to 2,000,000 lb per hr) is pumped to the new low pressure condensers in Waterside No. 1. Floating on this line is a Zeolite water storage tank with a capacity of 250,000 gal and representing a reserve of about one hour's make-up water, as a safeguard against temporary interruption of the city water supply.

At this writing the low pressure condensing units and one of the high pressure boilers and turbines are operating and it is expected that the second high pressure boilers and turbines will be in service before the end of the year.

MECHANICAL MUSCLES—INTELLIGENT INSTRUMENTS
or
Polish Up the Harp and Halo for the Power Engineer

Away back Anno Domini, you may remember when
The essence of a power-plant was able-bodied men,
And it didn't greatly matter what was compassed by your hat,
If you only had the muscles—and very little fat.
Them was the days!—the good old days; yet to add up the score
We're tickled unto giggles that they do exist no more.
So today we push a button or a lever is depressed,
And the big machines start humming; Hydro does the rest. (mebbe)
(The Ontario Hydroelectric Power Commission, mebbe?)

Feedwater nicely treated with chemicals galore,
Half a dozen gadgets tell it when to feed some more.
Equipment all co-ordinated . . . absolutely automatic,
With controls at every angle, from coal-pile up to attic.
Pressure variation not exceeding ten pounds flat,
Draft exactly equals pressure, pumps and fans are held at that.
One might garner a conception that the staff does little work,
As mechanic or as supervisor, as electrician or as clerk.

But these complicated gadgets that do everything but think
Go, just when you least expect it, absolutely on the blink.
"No returns from office annex;" "Coolers off in C North 3;"
"D-I showers, no hot water;" "Tunnel flooding, come and see;"
"Intake filter clogged with paper, air-conditioned 606,"
"Motor noisy;" "Pump off duty;" "Better send a man to fix."
Samples of the many incidents that fill your every minute,
Yet every kink that's ironed out has satisfaction in it!

Come along some nice cold morning, join the regular daily round,
When the cows come home to milking you'll be dragging on the ground.
Amperes, keyways, belts and elevators, coolers, heaters, P.R.V.'s,
En route to one you meet another—"instant," "vital," "urgent, PLEASE."
Troubles righted, back to office—someone in a mighty spleen
Calling for the last ten minutes! Off you go in haste again.
Replace his license with a medal; he has earned a restful bier;
Get a polished harp and halo ready for the engineer!

A. E. (Bert) Richards
Toronto, Canada

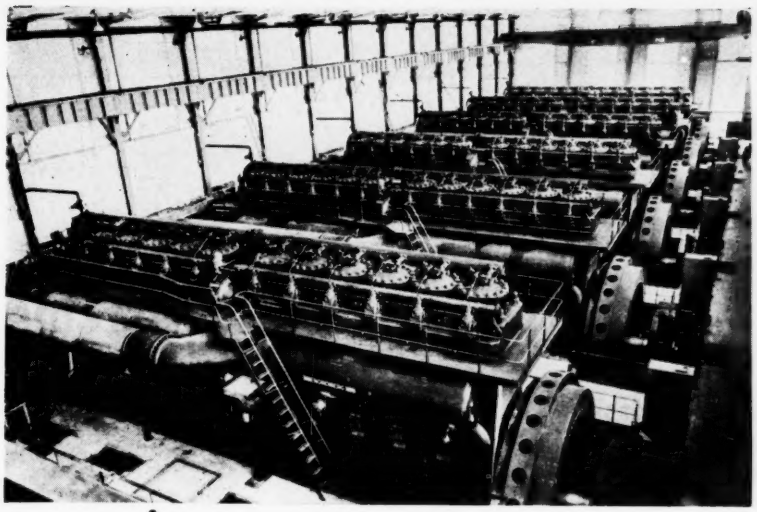


Fig. 1. General view of new Tacubaya Power Plant near Mexico City, with its six Nordberg two-cycle, 12-cylinder Diesel engines driving GE 7500-kva 0.8 pf generators, a total capacity of 30,900 kw at the 7600 ft elevation

Tacubaya Diesels Burn Heavy Fuel Oil

CONTAINING six of the largest Diesel engines ever built in the Western Hemisphere, burning heavy Mexican fuel oil Industrial Type A, commonly known as heavy or Bunker C oil, the new Tacubaya power plant near Mexico City went into operation in July. It is part of the Mexican Light & Power Co. system supplying power to the central Mexican plateau, in parallel with and supplementing the company's 15 hydroelectric plants.

The six engines in this plant are Nordberg units, of the two-cycle, crosshead type, with 12 cylinders each, 29 in. by 40 in., mechanical injection. Each unit is rated at 8650 bhp at 167 rpm at sea level and 7350 bhp at Tacubaya's 7600-ft altitude. They drive six General Electric 7500-kva, 0.8-pf, 6.6-kv generators.

Since the heavy fuel oil is difficult to handle, much thought was given to the design of the fuel handling system. At full load the plant will use about 51,000 gal of fuel oil a day, about five tank cars.

Tracks provide for unloading ten cars, by gravity flow, at one time, into two 800,000-gal storage tanks. Light engine-starting fuel and lubricating oils, also received by tank car are pumped into their respective storage tanks. The light-fuel-oil storage tank has a capacity of about 100,000 gal.

Characteristics of Mexican fuel oil received at Tacubaya are: Specific gravity, 60 F, 0.94-0.97; Viscosity, at 100 F, S.S.U., 1000-4800; Flashpoint, 180-260 F; Firepoint 240-315 F; Sulphur, 1.9-2.3%; Heat Content, Btu per lb, 18,200-18,600; Concradson carbon, 7.3-9.0.

This fuel is heated to about 210 F to obtain desired viscosity of 150 to 400 S.S.U. at the engine fuel nozzles.

The centrifuge building, housing equipment for fuel handling and cleaning, Fig. 3, is adjacent to the protective fire wall around the fuel storage tanks. Unloading and transportation pumps are in the basement, and five groups of hot water and electric fuel heaters, filters and De Laval centrifuges, each of 1000 gal. capacity, are on the upper floor.

Means are provided for purging the filters and cleaning the centrifuges. From the centrifuges, the fuel is pumped to the clean fuel service tank, in readiness for final heating and delivery to headers running the length of the power house. Fuel booster pumps of each engine take suction from these headers. Day tanks have been eliminated from the engine room, where no fuel is stored.

Copper tubing with sweated copper fittings, tin-antimony soldered, is used for clean-fuel piping. All hot fuel pipes are insulated with rockwool blankets, formed at the site; and underground pipes are finished with a coat of hard-setting cement. Routine efficiency checking is done with disk-type fuel meters in the flow and return pipes of each engine.

Coupled three-way valves, conveniently located near each engine, permit easy changeover from heavy to light fuel, or vice versa, for starting and stopping the engine.

Exhaust heat is used for hot water fuel heating. The twelve 36-in. exhaust snubbers on top of the main engine room are each equipped with 150 sq ft of heating coil, Fig. 2. These coils are all connected in parallel and 400 gpm of water is circulated through them. Two secondary heating circuits, each with its own pump, convey the heated water to heaters in a closed hot water system designed to operate at 240 F and supply all fuel heating needs.

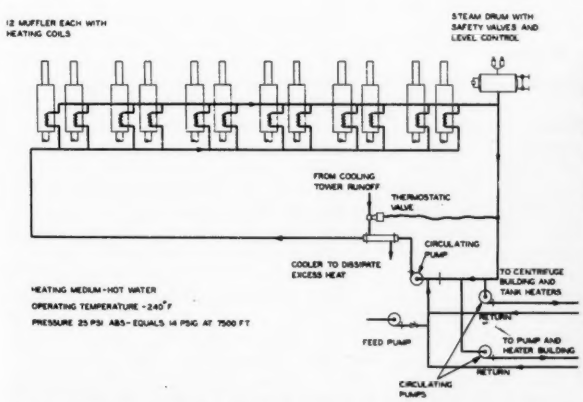

12 MUFFLER EACH WITH HEATING COILS
STEAM DRUM WITH SAFETY VALVES AND LEVEL CONTROL
FROM COOLING TOWER RUNOFF
THERMOSTATIC VALVE
CIRCULATING PUMP
COOLER TO DISSIPATE EXCESS HEAT
TO CENTRIFUGE BUILDING AND TANK HEATERS
RETURN
HEATING MEDIUM-HOT WATER
OPERATING TEMPERATURE - 240° F
PRESSURE 25 PSI ABS - EQUALS 14 PSIG AT 7500 FT
FEED PUMP
TO PUMP AND HEATER BUILDING
RETURN
CIRCULATING PUMPS

Fig. 2. Diagram of fuel heating system at Tacubaya Diesel Generating plant, showing how hot water, heated by engine exhaust, furnishes fuel oil heating in closed system

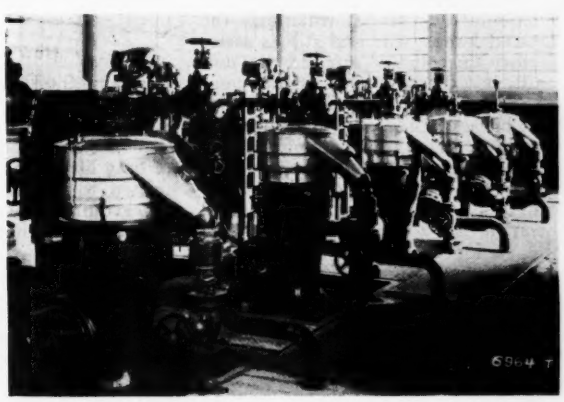


Fig. 3. View inside centrifuge building, near fuel storage tanks, showing DeLaval centrifuges for cleaning heavy fuel oil. Impurities are conveyed to disposal pit

MAINTENANCE

Locating Grounds on 480-v, 3-phase Delta Systems

By B. G. FORBES
Electrical Engineer, Bridgeport Brass Co.
Bridgeport, Conn.

Here is a maintenance tip that every power plant engineer as well as plant electrician will want to clip and put in his notebook though it is so simple and useful that such a permanent record may not be necessary. As pointed out by Mr. Forbes, the location of grounds on a large ungrounded electrical distribution system is not easy, and a great deal of time can be spent before they are finally located, that is, by older methods. With Mr. Forbes' scheme, however, such grounds can be located very quickly and with nothing more elaborate in the way of equipment than a cheap low range voltmeter. The method is so simple that, as Mr. Forbes points out, it should be common practice among electricians, yet it seems to be quite unknown to many of them

SOME YEARS AGO when our 480-v, 3-phase, 60-cycle ungrounded systems were modernized and enlarged, I introduced to our maintenance forces a method for locating grounds which has been of considerable assistance to them ever since. The method is so simple and direct that it would seem to be common practice, and yet, I have been told repeatedly by maintenance supervisors in various plants that it is new to them.

With the thought that the method may be of interest to other readers, I present the details as follows:

The old method of opening switches momentarily, while watching the ground lamps, was and still is satisfactory on some of our old d-c circuits, but the new a-c systems were equipped with heavy-duty air circuit breakers and any interruptions, however brief, would, of course, drop all of the motors on a feeder. Searching for a ground in large mill buildings covering many acres had been in every respect almost as futile as for the search for the proverbial needle in a haystack. Sometimes a ground would remain on for as long as ten days because it could not be located when the plant was in operation and automatically disappeared when the plant was shut down.

This method was suggested in response to a complaint by a substation operator that he had a ground of long duration which he was unable to clear after a thorough and time-consuming check of the entire area served from his station. It might be mentioned also that it was tried with some skepticism on his part and led to an area which he had previously suspected and had, therefore, checked with particular care. He expressed both chagrin and elation when he located the ground fault in a small fan motor, the contactor for which had frozen in, when the fault occurred in the motor winding. In his previous inspection, since the fan was not running, he had assumed that the contactor was open.

How It Works

The method suggested was essentially this:

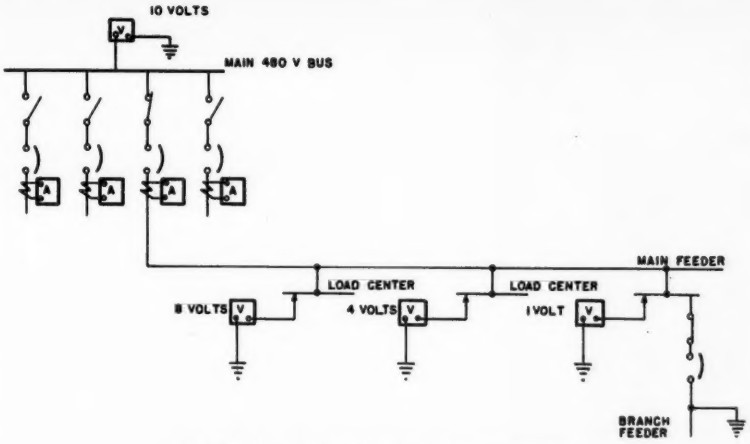
A voltmeter with a low scale, 0-10 or 0-15 v, was equipped with a pair of long leads, one of which was connected to ground and the other to the grounded phase of the distribution bus. By holding the meter in the hand and standing in front of each feeder panel in turn and watching the low-reading voltmeter and the line ammeters on the various panels, it will be observed that on one and only one of these panels the line ammeter and the low reading voltmeter move in exact unison with load fluctuations, just as though both pointers were on the same pivot. Since the low reading voltmeter is actually indicating the IR drop in the grounded cable between the bus and the ground contact, it will fluctuate in unison with line amperes. After a little experience, our operators were able to locate a grounded feeder within a matter of minutes while the plant was in operation and without any power interruption. It is obvious, of course, that the method can be used only while the feeder is loaded and, therefore subject to IR drop.

At this point the search for the ground has been narrowed down to one feeder, but the voltmeter can again be brought into play to show within reasonable limits just where the ground is located. By connecting the voltmeter between ground and the same grounded phase at the load center on the feeder nearest the bus, a voltage will be indicated just as at the switchboard but of smaller magnitude, unless, of course, the ground should happen to be on a local branch circuit, in which case the voltmeter deflection will be very small and it will be obvious that the ground is located on some branch circuit radiating from that load center.

Assuming that the ground is more remote from the source and by moving from load center to load center progressively along the feeder in a direction away from the bus, the voltmeter readings will become correspondingly smaller and smaller and the point where the smallest reading is obtained is then automatically in the immediate vicinity of the ground. It is then only necessary to check over the equipment in this limited area to find the trouble.

This method has been of particular value to us because of the length of our feeders, the large area served by each sub-station, and the importance of not shutting down drives which would affect material in process.

The operator using the method should, of course, be aware of the



Locating grounds with a low range voltmeter

fact that in the case of a feeder serving a number of load centers, the successive voltmeter readings will reduce in value both for the reason that he is approaching the ground location and also because the feeder load is reducing as he proceeds further from the main switchboard.

It might also be pointed out that electricians are able to determine by experience from the magnitude of the voltmeter reading obtained at the switchboard approximately how far away the ground is located. They are, therefore, often able to omit testing at nearby load centers.

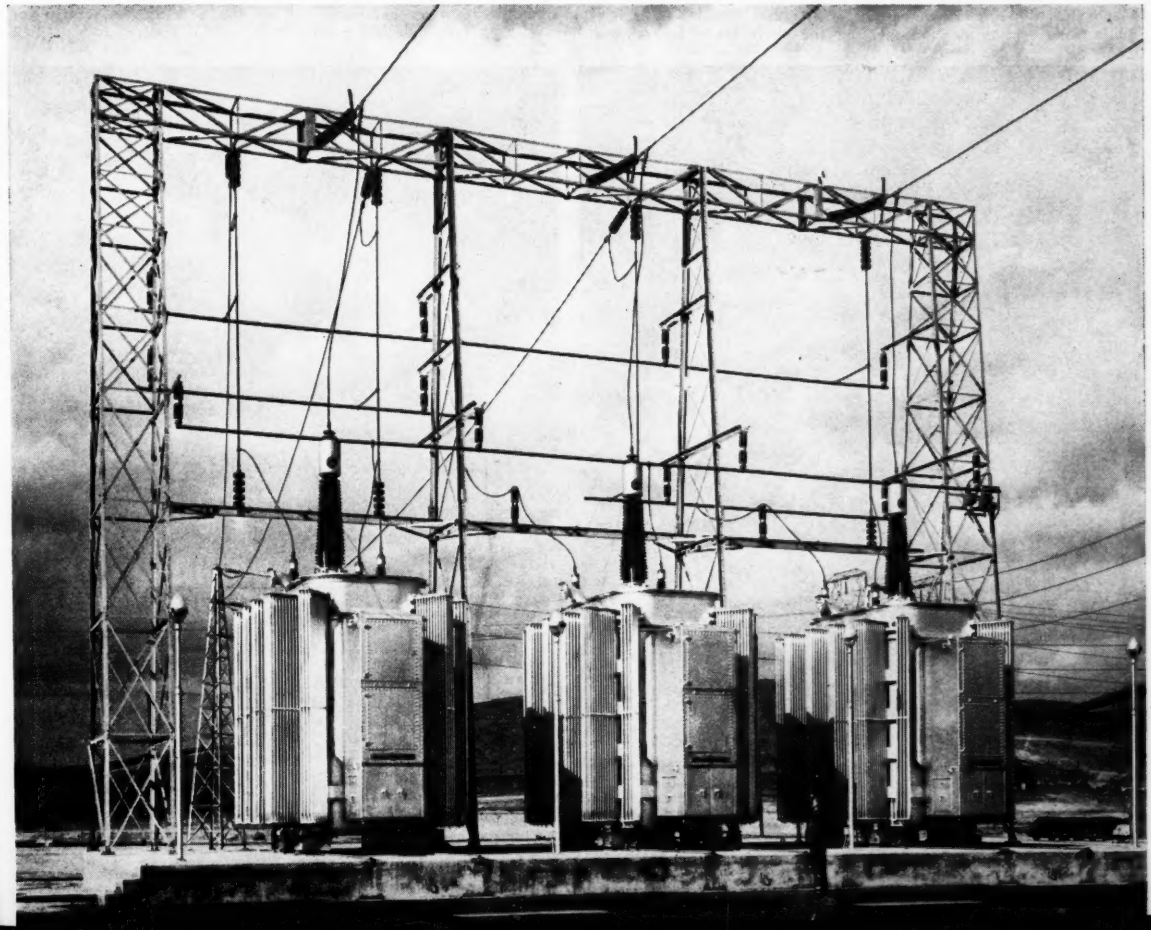
It should be mentioned that if at the moment of taking a reading with the voltmeter the ground should for some reason clear itself, the voltmeter would be burned out because it would be subjected to a static neutral voltage of some 275 volts. For that reason we use a cheap instrument, but so far have not had a ground clear while searching for it.

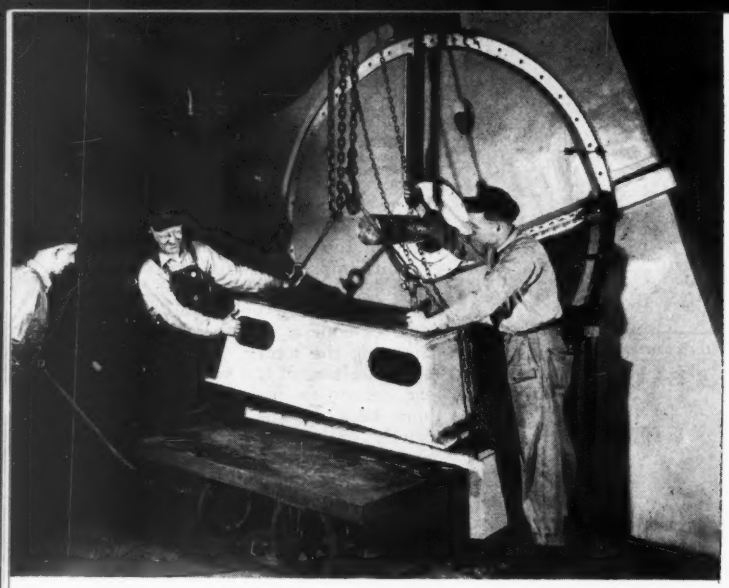
If the ground is momentarily or of short duration, the electrician in charge often will suspect a certain drive by the nature of the intermittency of the signal provided by the ground lamps. Searching for a fluctuating or momentary ground with the low reading voltmeter can be done, of course, only at the risk of damaging the meter.

The shifting of the voltmeter from load center to load center, connections being made at these points usually by opening the door of a convenient safety switch or motor control, is equivalent to moving the slider along an old-fashioned simplified form of Wheatstone bridge. If the grounded feeder were an uninsulated trolley paralleled by a bare ground conductor, the voltmeter connected to sliding contacts could be moved along the feeder and ground cables to the point of zero deflection, which would, of course, be the location of the ground. Testing at successive load centers approximates this operation. The attached simple diagram illustrates a typical case.

More Power For More California People

Keeping pace with the industrial growth in California, Southern California Edison Co. has recently installed three new General Electric power transformers. The transformers at the Mesa Substation are rated OA 60-25,000 kva, 220,000 v, GrY to 73,090 v. An additional three transformers have been ordered and will be installed to the right of those pictured and in line with the installation.





A Picture Story from Delray

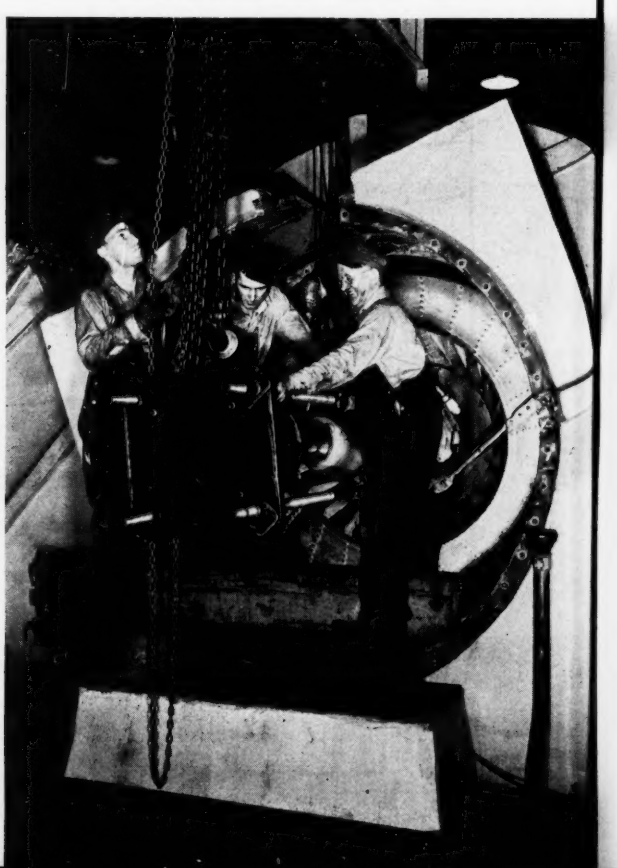
Photographs by Photographic Division, The Detroit Edison Co., through courtesy of *Coal to Kilowatts*, a publication of that company's Production Department

Fig. 1. STEP 1—Mechanical Repairmen Carl Black, Joe Jolly and Charlie Steinbrecker, (l to r) remove the steel section of the bearing pedestal to permit removal of the fan casing end. This pedestal was originally of solid concrete construction

New Maintenance Method Cuts I. D. Fan Outage from 1 Week to 16 hr at Delray

Fig. 2. STEP 2—The end of the fan inlet box is lifted off by Mechanical Repairmen Ben Bak (left) and Earl Newsted. The inlet guide vane section can be seen on the shaft ready for removal

Fig. 3. STEP 3—Elmer Fox, Wayne Hatfield and Joe Jolly (l to r) mount a 100-ton condenser jack on the end of the shaft after fastening the pulling rods to the fan rotor



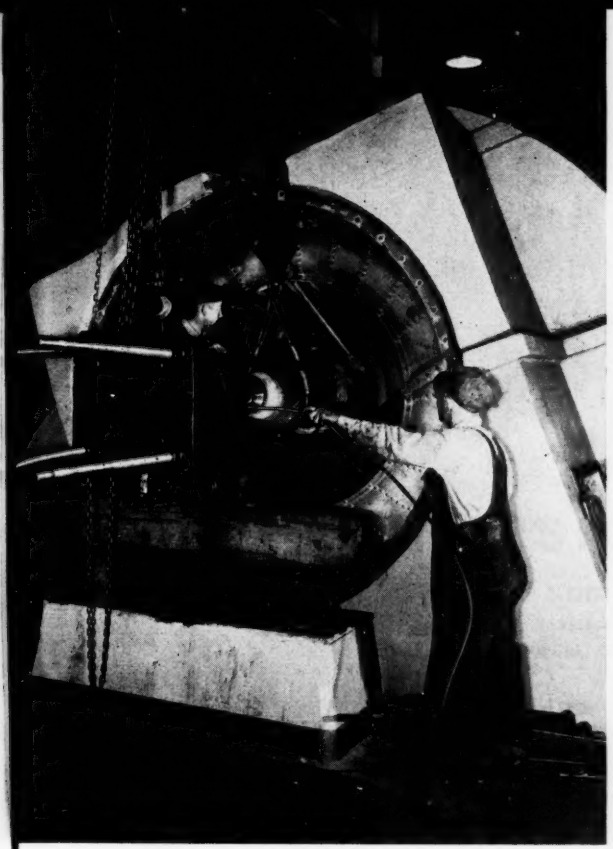


Fig. 4. STEP 4—The rotor is pulled out as hydraulic pressure is applied to the jack. Earl Newsted and Joe Jolly watch the rotor movement

Fig. 6. STEP 5—After the shaft has been cleaned, the spare rotor slips on fairly easy. Joe Jolly (left) and Wayne Hatfield push it into final position with a light jack

AT THE DELRAY Station of The Detroit Edison Co., Detroit, Michigan, it was necessary to reduce the outage time required for induced draft fan maintenance. Fan outage means boiler outage and possible reduction in plant generating capacity.

The blades of the induced draft fans, discharging the flue gas to the stacks, are subjected to a certain amount of bombardment by dust particles in the gas. The volume of flue gas is so large that even a few per cent of dust in the gas forms a large total amount. The dust particles cause some blade erosion and eventually the fan blades must be replaced.

Formerly this maintenance involved cutting into the fan casing to replace the blades on the spot. This was slow work, time-consuming—took about a week per fan.

Inventive minds then went to work and came up with the present method, shown here in pictures. Now the Delray maintenance crew can have the fan ready in the remarkably short time of 16 hr. Begin at Fig. 1, follow the figure numbers.

Fig. 5. Here is a spare rotor kept ready to replace the removed rotor on the shaft. The removed rotor is set aside to be reconditioned as time permits

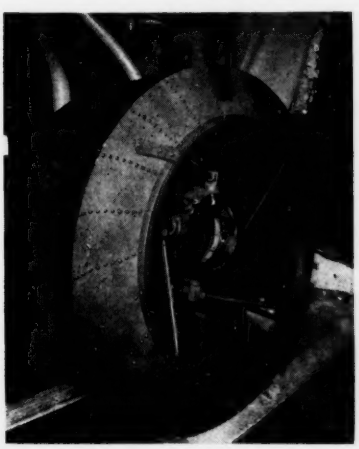
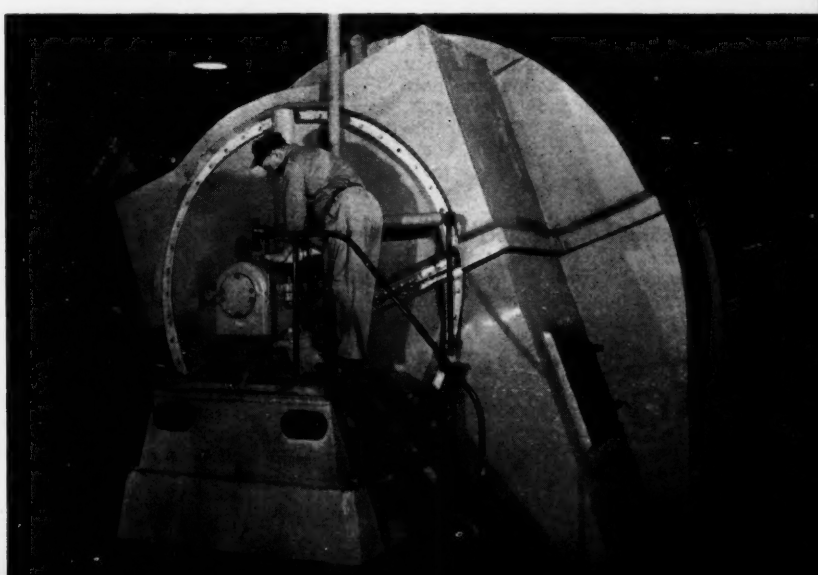


Fig. 7. STEP 6—They're off! Sixteen work hours after the start of the job, the casing is slicked up and the fan is rolling. Here Fan Operator Urban Meir checks the bearing oil rings



Why Continue These Practices?

By A. G. CHRISTIE
Professor Emeritus of Mechanical Engineering
The Johns Hopkins University

ROBERT BURNS, the very human Scottish poet, expressed the wish that we be given the power to see ourselves as others see us. This thought applies to many industrial executives who have become so accustomed to seeing things as they are in their power plants and factories that they fail to appreciate how these conditions appear to others. As a result the gains that may be made by improvements, often small in first cost, are overlooked. Many such men do not have the time nor the technical training to analyze all situations. However, some simple questions may arouse their interest or direct attention to existing situations. The following questions cover conditions often encountered in industrial plants together with certain comments on the specific problems.

• • •

Why continue the use of old and inefficient equipment such as boilers, pumps, engines, etc? Coal and labor are both high priced and will probably remain so. Savings can be effected by modern high efficiency equipment. With equipment now available at reasonable deliveries, this is the time to prepare for the better business that will come shortly.

• • •

Why use low paid labor to fire high priced coal? Unintelligent furnace operation often wastes coal worth several times the difference in wage rates between a poor and a good fireman.

• • •

Why are workers given no additional training? Training increases the competence and intelligence of the worker. Trained men work more efficiently and do better work. Training brings large returns. Also older men benefit from occasional refresher training as shown by war courses.

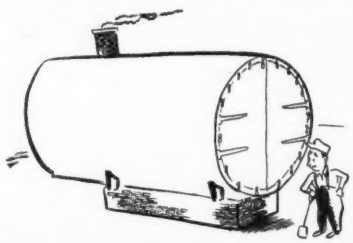
• • •

Why are there no coal and ash handling equipments? When the boiler plant reaches a size that one or more men are employed to wheel

or truck coal and ashes, then it is time to let machinery do the work at less cost. Equipment can now be had for the smallest plants.

• • •

Why continue to build small furnaces under boilers? These are very costly when measured in terms of inefficiency. Also they are frequent-



ly the cause of offensive smoke which may subject the owner to fines. Any consultant can advise on proper furnace volume.

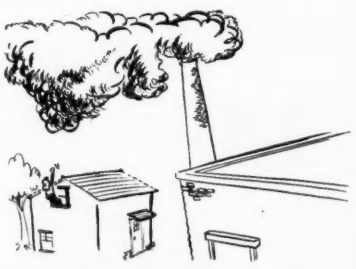
Why leave uncovered the pipes and ducts that convey hot fluids? Insulating materials generally pay for themselves in less than a year by the fuel saved from decreased heat losses.

• • •

Why permit the boiler room to continue poorly lighted and dirty? No employee takes pride in such a place. Service is proportionate to the interest of the worker in his job. Give him something to command his interest and self respect and he does better work.

• • •

Why continue to discharge smoke and dust over the neighborhood? This in the future will leads to fines or imprisonment in many places. Smoke indicates costly and inefficient operation. Get the best dust



catcher available as soon as possible. Adopt more economical firing methods. This in some cases may require overfire air for the furnace.

• • •

Why use boiler compounds for feedwater treatment? The place to remove impurities from boiler water is outside not inside of the boiler. Inside removal requires frequent boiler outage for inspection and

cleaning which costs money. Good feedwater treating plants are available at moderate price to remove impurities outside of the boiler.

• • •

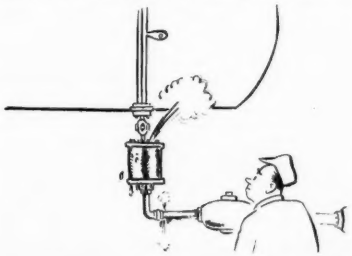
Why buy steel casings for boilers? Plaster casings properly installed give as good or better service than steel casings and cost much less.

• • •

Why use water columns on boilers? These are not used in British and Canadian practice. They add from several hundred to a thousand dollars or more to the boiler cost. Many leave them off recent boilers.

• • •

Why allow leaking boiler settings, breechings and dampers to continue? Losses ultimately are reflected in increased operating expense. It costs little to correct leaks and effect substantial savings.



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Why build large chimneys? Tests have shown that draft losses in chimneys have been over-exaggerated and that much higher gas velocities can be used than was formerly deemed acceptable. Smaller chimneys reduce first cost and decrease foundation loadings and expense.

• • •

Why line chimneys with brick? Induced draft fans do not require hot chimneys to produce draft. Fire brick linings seem absurd for the temperatures that prevail in chimneys of modern power plants where common red brick would serve every purpose. Steel chimneys lined with gunite have given excellent service even with high sulfur coals. Such are also less expensive than brick-lined units.

• • •

Why are low efficiency fans still tolerated? Developments of compressors for gas turbines have shown that it is possible to build fans of much higher efficiency than the usual commercial unit. Low efficiency fans involve high cost operation due to the excess power used. High efficiency fans would be much cheaper in the long run.

• • •

Why use so few operating instruments? These, such as boiler efficiency meters or indicators, rate-of-flow meters, fuel measuring devices, etc., all serve to set standards of performance for the operators and keep these men up to certain desired accomplishments. Savings from more efficient operation have paid for these instruments in some cases in less than a year's time.

• • •

Why tolerate poor vacuum? A condenser expert may quickly locate and correct the faulty apparatus Lower vacuum with turbines decreases steam consumption and lowers coal bills.

• • •

Why waste the heat in the cooling water of condensers? This has been used for space heating of industrial plants in winter by increasing the back pressure in the condenser to secure necessary high outflow temperatures on cold days. Another plant delivered the water to heat neighboring greenhouses for winter vegetables. Other uses can be found for such heat which may represent two-thirds to three-quarters of the total heat in the fuel burned.

• • •

Why permit low power factors for industrial loads? Correction can be made by using synchronous motors in places requiring large blocks of power. Capacitors at certain distribution points can correct power factor for groups of motors or other loads. Improved power factor decreases distribution losses and in many cases reduces power bills when energy is purchased and the customer is penalized for low power factor.

Extractor for Economizer Tube Plugs

By G. AMADOR de los RIOS

SOME TIME ago I worked in a steam power plant in which, every four weeks, the economizer elements of the two boilers were inspected and turbined. This job was always done on Sunday, because the plant lacked a spare boiler.

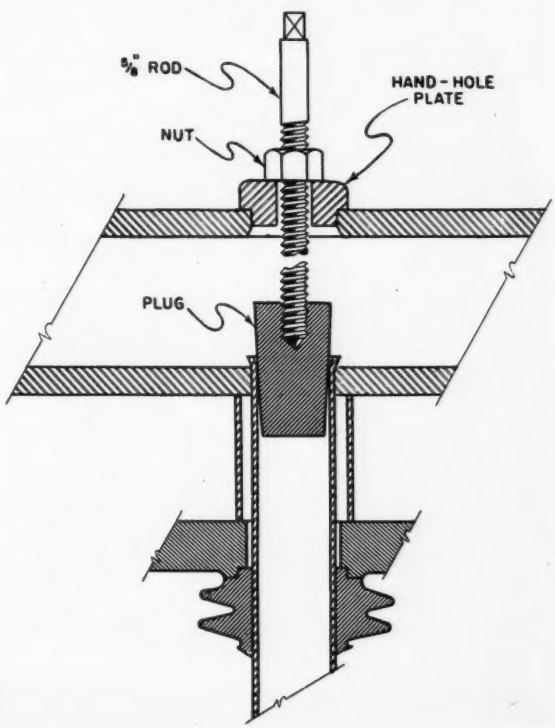
After cleaning with the air cleaners, the tubes were inspected for leakage. If any one was found leaking, it was immediately plugged as shown, so that the economizer could be put back into service on Monday without waiting for repairs.

Then, every six or seven months, we shut down for a longer period, took out the broken tubes and replaced them with new ones.

All tube plugs used were provided with a 5/8-in. threaded hole in the top end as shown.

To remove the plugs in the leaking tubes we made an extractor, as shown in the attached drawing. One end of a 5/8-in. rod of suitable length was provided with thread to screw into the plug, and a good husky nut was threaded on up to about the middle of the rod. The other end of the rod was squared off to take a suitable wrench for screwing the rod into the plug.

A hand-hole plate was used as a support for the extractor and the plug was drawn out simply by turning the nut clock-wise.



How a plug extractor was made and used on economizer tubes that had been plugged to permit economizer operation without waiting for repairs

New High-Voltage Engineering Laboratory at Pittsfield

THE NEW high-voltage engineering laboratory recently opened by the General Electric Co. at Pittsfield, Mass., is capable of producing the most powerful lightning bolts ever created by man-made apparatus.

At the opening demonstration, Julius H. Hagenguth, engineer in charge of the laboratory supervised the firing of artificial lightning with a peak of 15,000,000 v. This discharge (Fig. 2) occurred across a 50-ft gap between two impulse generators in the huge demonstration hall of the laboratory.

Other demonstrations showed the effects of lightning on power transmission lines; on a golfer, using a clothiers dummy as a model; and upon a model city with bolts of lightning striking the small buildings and putting out the light when proper protection was not available. When proper precaution was provided, the lightning bolt hit the buildings repeatedly without affecting the lights.

Fig. 1. A strand of copper wire disappears in a streak of flame as 5,000,000-v of electrical power surges along it. The discharge completely vaporizes the wire

The giant steel and concrete building, whose main demonstration hall has an 85-ft ceiling, was constructed at an approximate cost of more than $2,000,000, including equipment.

The laboratory is divided into four main parts: the High Voltage Hall, where the powerful surges of artificial lightning are generated; the low bay building, where tests are run on various types of equipment; the controlled-temperature laboratory, in which high voltage tests are conducted under varying degrees of temperature and humidity; and finally the offices, including a lecture room, five photographic darkrooms, chemical and physical laboratories, mechanical and electrical workshops, and other special test rooms.

High Voltage Hall, which measures some 165 ft in length and 85 ft in height, contains the two 5,100,000-v impulse generators capable of producing a peak of 15,000,000 v between them, the transformers, and controls used to produce the powerful strokes of lightning. No conventional windows are in the large room, since the research frequently requires total darkness. Especially constructed louvres and ventilation systems keep fresh air coming into the room and keep out dust.

The room is so high that a special two-man elevator was installed in one corner of the room to carry the crane operator to his cab in the overhead-crane and to permit maintenance work.

One of the giant generators, which is more than 50 ft high, is mounted on a low flat car so that it may be moved to an outdoor test area of some 7200 sq ft. The outdoor test area is used to conduct experiments on high-voltage transmission lines and on equipment too large to bring inside.

The rails on which this generator is moved extend about 60 ft into the fence-enclosed, hard-surfaced, test area.

An especially electrically operated door some 50 ft tall and 14 ft wide

is provided for taking the generator outside the Hall.

A gallery capable of holding some 200 people is used for observation and two "crow's nests" are provided above the main gallery for observation and photographic equipment.

The controlled-temperature room is constructed of specially insulated aluminum walls and will be used to conduct high-voltage tests in temperature conditions varying from zero to 100 F and varying degrees of humidity.

The Low Bay Building, which contains the controlled temperature room and offices, also houses six other small test areas.

The photograph locations in the High-Voltage Hall and the five darkrooms are necessary because many of the studies of high-voltage phenomena and lightning are done with cameras.

The work of the laboratory is divided into two main parts: (1) investigation of general interest to the electrical industry and (2) work of interest in the design of better, lower-cost electric equipment.

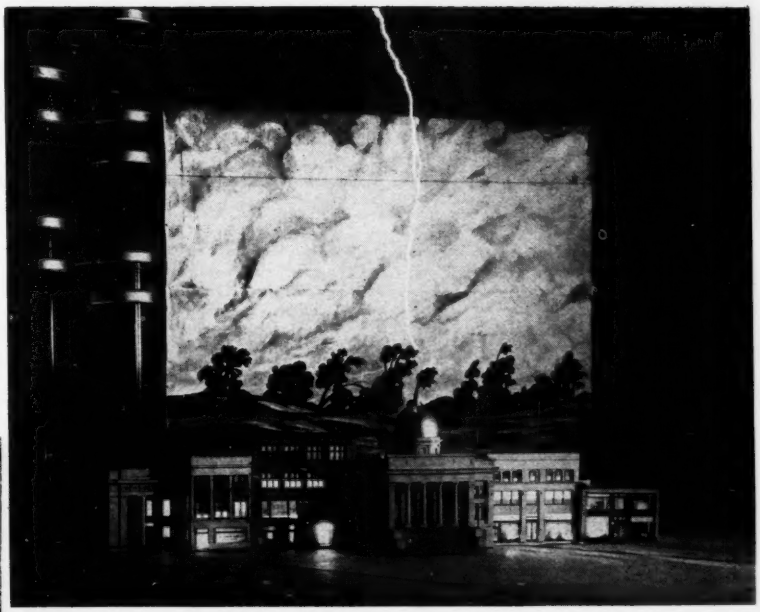


Fig. 3. (above) A model city is struck by lightning and the lights go out. After proper protection was provided a second stroke had no effect

Fig. 2. (left) Photograph of a 15,000,000-v bolt of lightning leaping 50 ft between two impulse generators at the Pittsfield laboratory.

FILTERS AS FUEL

WE HAVE around one hundred oil filter units that are removed from Diesel locomotives each week. These were a disposal problem until someone inquired into the possibility of burning them under our boilers.

As these units have a metal core, there was a question as to whether the melting metal would interfere with air space in grates. We made a trial run on one half of a grate surface and found the metal gave no trouble. We have been burning these units now for a little more than a year.

I estimate there is from 2½ to 3 gal of oil in each unit. We usually wait until we have about 200 units before burning them and this gives us about an 8-hr run, *using no coal.* We save about 5 tons of coal each time we fire with these units, which were formerly carted to the dump and burned there.

They are a little on the smoky side; but, with an increase in overfire air, the smoke is kept to a point where we have as yet no complaints. This procedure, of course, will depend on the type of stoker or grate used and other factors of local nature. Also it would apply only where Diesel locomotives are serviced.

As to the metal in the filter units, there seemed to be very little melting. At the end of period of burning, we raked the metal cores out with the little ash that was left on the grates.

Today, out of curiosity I weighed some units and find they tip the scales at 25 lb when oil-saturated. The dry units weigh about 5 lb, the core 1 lb. I estimate about 18 to 19 lb of oil to a unit. If the grates are not too long, they can be fired as is; but with grates 10 ft long, as with our new installation, we find it much better to remove the cores and shovel-fire.

A word of caution: the cores have sharp edges and it's advisable to wear gloves when handling, otherwise they may make nasty cuts.

I expect to have between 190 and possibly a little better than 200 units to dispose of Sunday. These will carry our normal Sunday load for 7 to 8 hr with the coal feed entirely cut off.

Mechanicville, N. Y. R. F. LEACH

CARROLL, BECHTEL AND LANGTRY NOW UNDER THEIR OWN NAMES

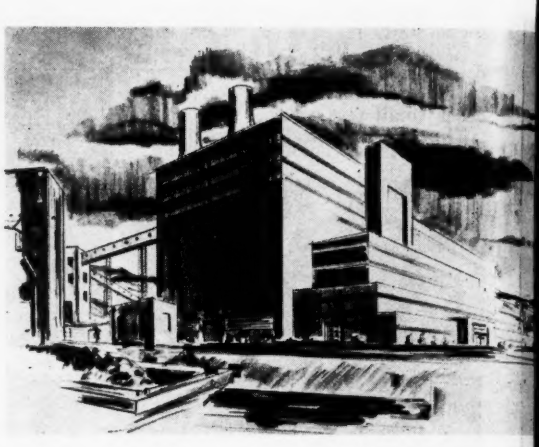
CARROLL, BECHTEL AND LANGTRY, power plant consulting engineers, is the new name recently announced for what has been for some time a division or subsidiary of Commercial Testing and Engineering Co., 307 North Michigan Avenue, Chicago 1, Ill.

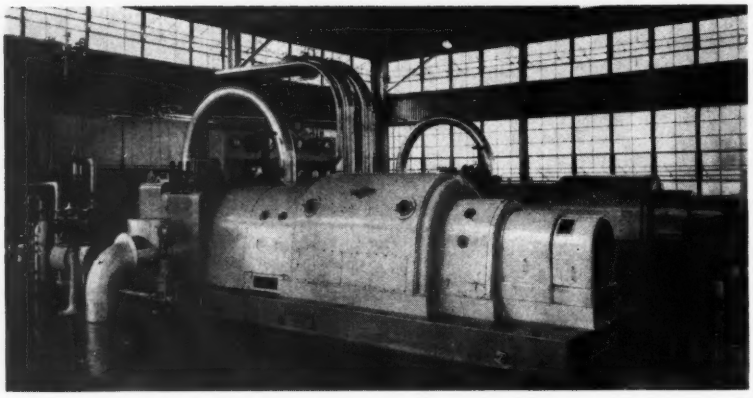
The Engineering Department of Commercial Testing & Engineering Co. was organized at the end of World War I. Since that time it has specialized in power plant consulting engineering and combustion efficiency.

Power Generation

Left — Four of the largest single-stage ejectors ever built by Elliott Co. Standing 22 ft tall, they have 24-in. suction openings and each ejector consumes 75,000 lb of steam an hour. They were built to serve a ram-jet test stand in an aeronautical laboratory

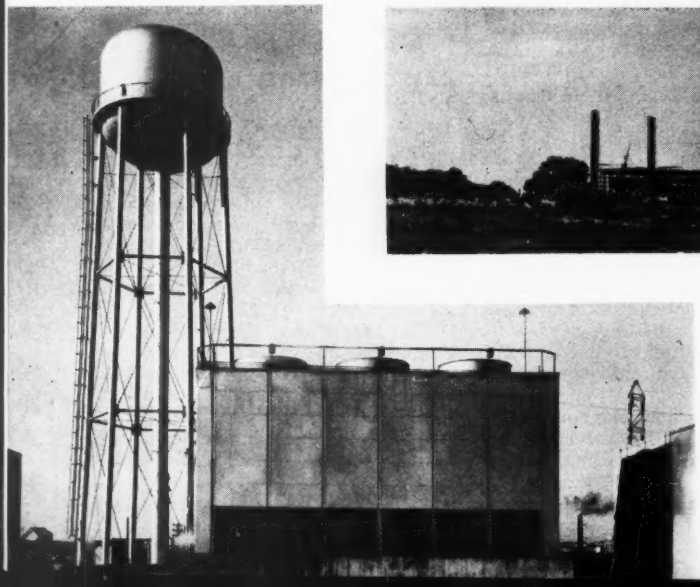
Right — Architect's drawing of Elrama Power Station, designed by Duquesne Light Co.'s engineers, to be built by Dravo Corp. at Elrama, Pa.

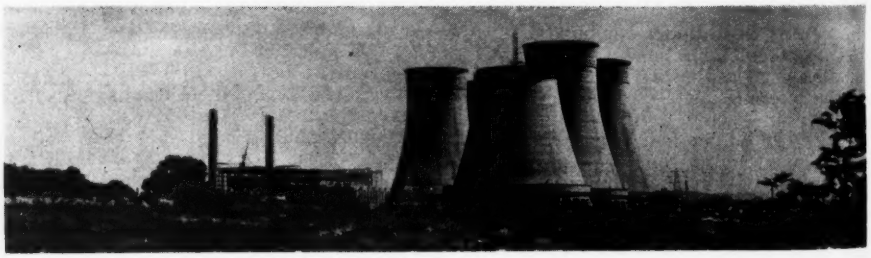




Left—Two turbine generators at the El Paso Natural Gas Co., Eunice, New Mexico. Besides driving the turbines, steam is used in the process of removing impurities from natural gas.

Each generator is rated 1875 kva, 480 v, 0.8 pf, 3600 rpm and they were furnished by the Electric Machinery Mfg. Co. Each is driven by a Worthington Moore non-condensing extraction steam turbine. Generators are totally enclosed and ventilated by water-cooled air circulated from coolers installed in the basement below. Electric power from the generators drives many circulating pumps and cooling fans involved in the processes



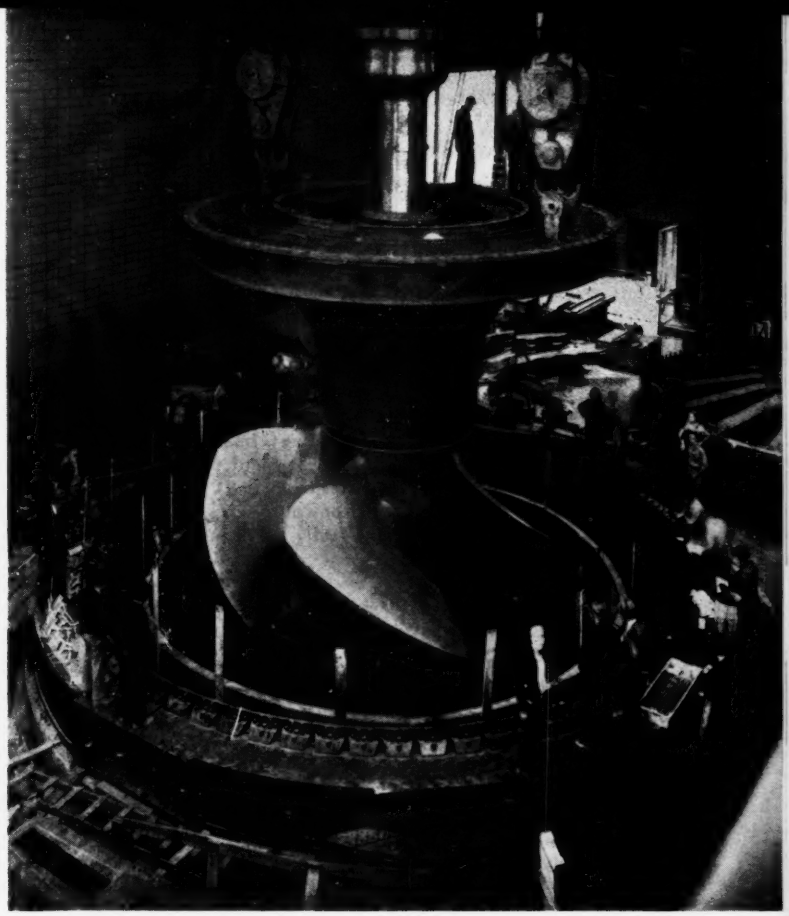


Above—Cooling towers, English style. Reinforced concrete "submerged milk bottles", with capacity of 5,000,000 gal per hr of water, erected to serve new Croydon generating plant at London, shown under erection in background. This is one of 38 new British plants

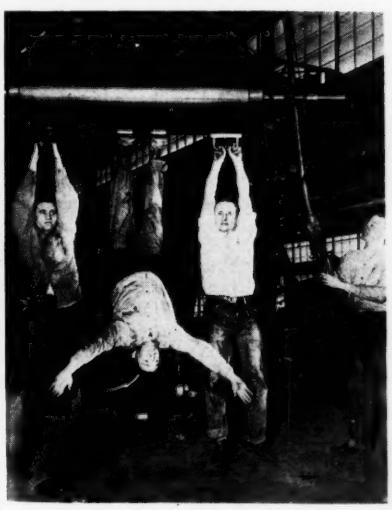
Left—Water storage tank and cooling tower, American style, for new Caterpillar Diesel engine factory building at Peoria, Ill. The Binks induced-draft tower is in 3 sections, each of 1000 gpm capacity, designed to operate with water on at 150 F off at 180 F, with 76-deg wet bulb temperature

NEWS REEL

Stephen Sivy of Trenton, N. J. adjusts the rigging reels on a 10-ton vertical layer machine making 20 miles of wire rope for elevators in the new United Nations Secretariat Building, New York

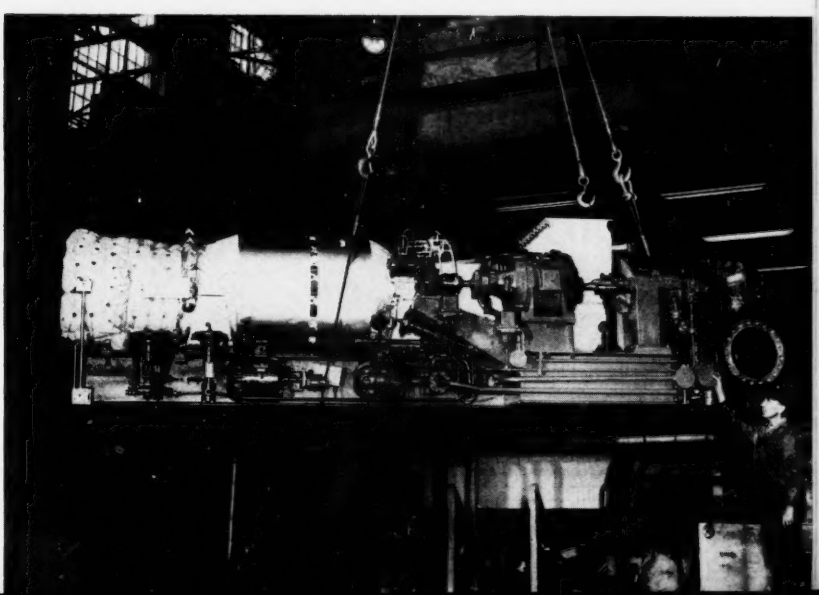


Above—Last of four hydraulic turbines for power house at Chickamauga Dam of TVA on Tennessee River, has been ordered from Baldwin for delivery in August, 1951. Blades of the 42,000-hp 72-rpm turbine are automatically adjustable to give maximum efficiency under different water conditions



Claimed to be world's largest magnetic pulley employing Alnico, this pulley, built by Dings, was recently shipped to Pennsylvania Glass Sand Corp. at Hancock, W. Va., to remove iron from glass sand. Pulley is 24 in. in diameter, 60 in. wide, includes 1500 lb of Alnico

Below—View of Westinghouse 2000-hp gas turbine line pump unit (see PG, July 1949, pp 102, 104) in slings, being shipped to Mississippi River Fuel Corp.'s pumping station at Wilmar, Ark. Gas turbine and axial-flow compressor at left. At right is direct-connected Ingersoll-Rand centrifugal gas booster. In center, starting motor, turning gear, lubricating system and other auxiliaries. Unit rated at 1850 hp output to gas booster, inlet air 14.7 psia, 100F



WATER TREATMENT

Comparison of Conventional and Sludge-Blanket Softeners at a Firestone Plant

Unusual opportunity to compare performance of two hot-process softeners of same capacity treating same water in same plant, occurs at plant of Firestone Tire & Rubber Co., Pottstown, Pa. . . . One a conventional hot-process unit installed in 1945, other a sludge-blanket unit installed in 1948 . . . Details of operation . . . Test data, from both units, on silica removal, turbidity, back-washing, filter loadings . . . Sludge-blanket unit consistently produced water with smaller silica content and lower turbidity.

By **R. E. BURNS**, The Permutit Co.
and
JOHN WOOD, E. F. Drew & Co., Inc.

ALTHOUGH the sludge-blanket hot-process softener has been in use in a number of power plants since 1946 and has established its value by outstanding performance, it is a relatively new entity in the lime-soda softening field. Hence a comparison of the results obtained when similar waters are treated in the same plant by a conventional and by a sludge-blanket designed softener should be of considerable interest to the power industry. An opportunity to make such studies is available at the Pottstown, Penna., plant of the Firestone Tire & Rubber Co.

An 8,000-gph conventional unit, Fig. 1, which contains deaerating equipment, was installed in 1945. Auxiliary equipment consists of 3 anthrafilt filters and chemical feeding facilities. At present, this softener is employed in the treatment of process water.

Early in 1948, an 8,000 gph sludge-blanket softener, Fig. 2 and Fig. 3, was put into operation, but unlike the conventional apparatus, the softened makeup water is not deaerated. Both units were manufactured by The Permutit Co.

Each of these softeners at present operates 24 hr a day at 40 to 70 per cent of rated capacity. The makeup water supplied to both units is well water of approximate composition shown in Table I. Normally the conventional softener handles, in addition to makeup, varying quantities of treated water returned from plant processes. In order that the performance of these units might be studied under similar operating conditions, the Firestone officials reduced the treated water returned to a minimum, during the period of these observations.

In the conventional softener, Fig. 1, raw water and chemicals are sprayed into a tank, at which time

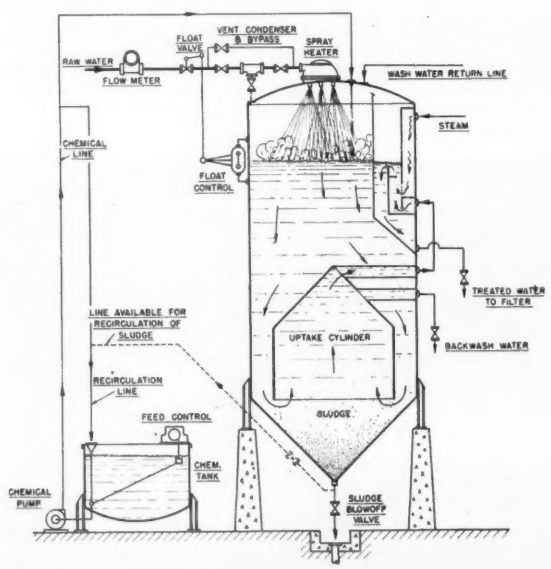


Fig. 1. Diagrammatic cross-section through conventional hot-process softener at Firestone plant, Pottstown

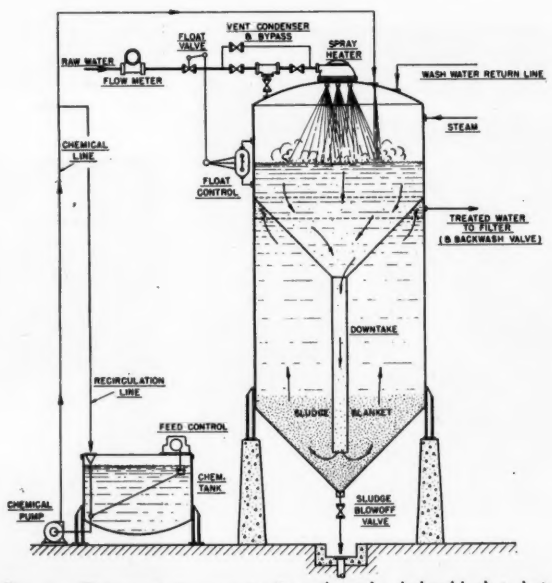


Fig. 2. Diagrammatic cross-section through sludge-blanket hot-process softener at Firestone plant, Pottstown

TABLE I
Typical Analysis of Raw Water

Total hardness as $CaCO_3$	208 ppm
Calcium hardness as $CaCO_3$	120 ppm
Magnesium hardness as $CaCO_3$	88 ppm
Methyl orange alkalinity as $CaCO_3$	96 ppm
Phenolphthalein alkalinity as $CaCO_3$	0 ppm
Silica as SiO_2	25 ppm
Chlorides as Cl	7 ppm
Sulphate as SO_4	120 ppm
pH	7.7
Temperature	70 F.

TABLE II
Turbidity Effects During Backwash of Filter

Sludge-Blanket Softener Time	Turbidity	Conventional Softener Time	Turbidity
Before Backwash	2	Before Backwash	12
After start of backwash		After start of backwash	
1 minute	3.3	1½ minutes	15
3 minutes	10	4 minutes	22
4 minutes	50	6½ minutes	30
		10 minutes	35
At end of backwash (6 minutes from start)	82	At end of backwash (18 minutes from start)	38
After end of backwash		After end of backwash	
7 minutes	40	4 minutes	30
10 minutes	18	10 minutes	19
27 minutes	0.8	21 minutes	12

oxygen reduction, CO_2 removal, and heating occur. The high velocity of water from the sprays agitates the surface and effectively mixes water and chemicals. The reaction of the softening chemicals proceeds as water passes downward. Before the water reaches the bottom of the uptake chamber, the reactions of the chemical are substantially complete. The precipitates settle toward the conical bottom of the softener.

Clarified, settled water passes upward into the uptake chamber. In this unit, water passes through the steam scrubber of a deaerator before the treated water passes to the filters.

In the sludge-blanket softener, Fig. 2, the raw water and chemicals are sprayed into an upper funnel-like cone where mixing and initial reaction occur. This mixture flows downward through a central cylinder or pipe. Upon reaching the bottom, the water turns upward through the conical base, wherein the decreasing upward velocity causes the precipitates to remain in a suspended position, thus forming a sludge-blanket. Finer particles are carried to the upper regions of the blanket, while the heavier particles remain in the lower section. The sludge particles tend to agglomerate and grow in size, as in the more familiar Permutit (Spaulding) cold process precipitator.

In units of this design, the heaviest particles in the blanket "creep" down the sides of the cone to the apex where they are removed by the blowdown valve.

The sludge blanket, which acts as a filter for screening out fine particles of precipitated matter before the water passes into the cylindrical section of the tank, is now well known for producing an effluent of very low turbidity. The comparative observations made on these softeners demonstrate in a quantitative manner the effectiveness of this design.

Observations Made

To the power plant engineer and operator, features of particular importance in the lime soda softener, in addition to hardness, are silica content, turbidity of the water passing to the filters, and resultant backwashing frequency. An effort was made to obtain data on these factors from both units under varying operating conditions.

To accomplish this, the chemical dosages were altered several times, as were certain physical conditions, such as changes in depth of the sludge-blanket in the newer softener and use of sludge recirculation in the older.

Effluent Turbidities

During normal operation of the sludge-blanket unit, the top of the blanket is maintained slightly above the top of the conical base of the softener. Throughout a prolonged period of observation, the effluent from this unit was 2 to 4 ppm. Occasional increases to between 5 and 10 ppm were noted, but these were infrequent and of short duration. Decreases to less than 1 ppm were also observed, but 2 to 4 ppm is typical of the effluent from this softener.

When the sludge-blanket level was raised approximately 6 ft to 8 ft above the conical base in the straight portion of the softener, the turbidities averaged 1 ppm. Lowering the level, and thus decreasing the volume and depth of the blanket to a point several feet below the top of the conical base, resulted in turbidities up to 9 ppm. This latter condition may occur during normal operation if excessive blowdown of the

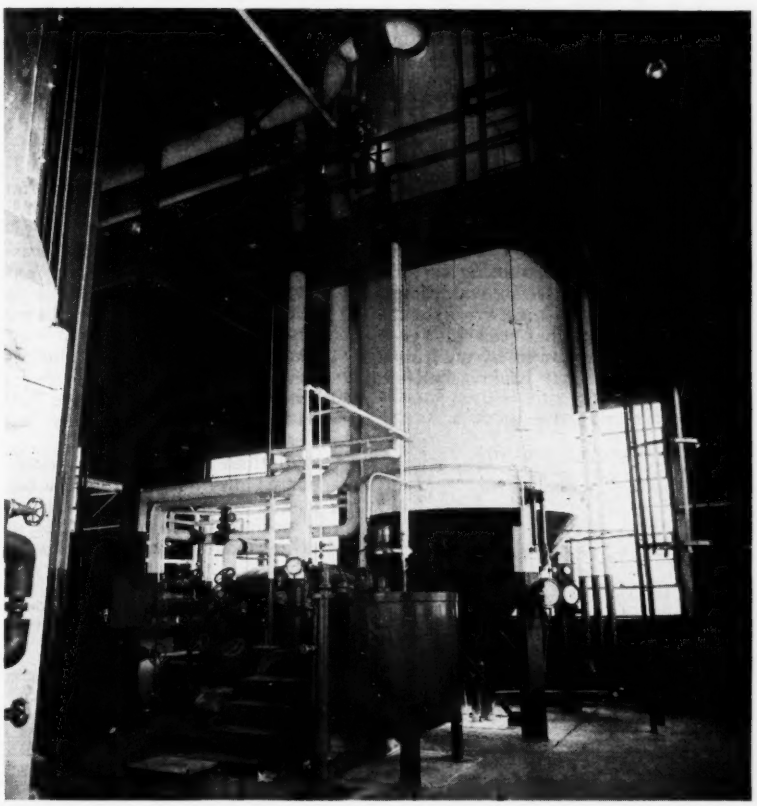


Fig. 3. View of sludge-blanket hot-process softener as installed in Firestone plant at Pottstown

sludge is permitted. See Fig. 4.

Conventional-unit turbidities averaged slightly under 12 ppm. The range of observed turbidities was 7 to 19 ppm. However, turbidities higher than 13 or less than 11 ppm were infrequent, Fig. 5. Tests made on the treated effluent of the conventional unit during the sludge-recirculation period showed no appreciable reduction in turbidities from these noted when the softener operated normally.

Calculations have been made to determine the normal quantity of turbidity passing to the filters from each of these units in an hour. The conventional unit discharged approximately 0.4 lb per hr to the filters. The sludge-blanket equipment discharged only an average of 0.07 lb per hr, less than 1/5 of the former quantity. This indicates a reduced load on the filter in the sludge-blanket system, which in turn reduces the required frequency of backwashing of this filter as compared with that required in the conventional system.

As stated above, normal operation maintains the top of the sludge-blanket slightly above the top of the cone. This practice allows appreciable rising of the sludge-blanket during backwashing without excessive turbidity carryover at that time.

In this instance, however, the sludge-blanket unit is backwashed at unusually high rates and a brief interval of high turbidity in the effluent occurs as the sludge-blanket reaches the discharge point, since the precipitated solids are localized and highly concentrated. This interval is followed by a rapid return to normal turbidity as soon as the backwash period ends. When backwashing the conventional softener at lower rates, turbidities are not as high as those in the sludge blanket unit. That the localized concentration of sludge is not directly in the line of flow may be considered a contributing factor.

In reality, backwashing conditions were not similar in the two systems at Firestone in that the sludge-blanket unit is followed by only one 96 in. diameter filter backwashed at 550 gpm; whereas the conventional unit is followed by three 66 in. diameter filters, each of which is backwashed in turn at 265 gpm while the other two remain in service. The backwash water is returned to the top of the softener in each case.

In connection with Table II, during the interval immediately preceding backwashing, both units were operating at approximately 50 per cent capacity.

The backwashing flow rate of 550 gpm through the sludge-blanket softener represents an increase to 480 per cent of rated capacity. In the case of the conventional unit, the backwash flow rate of 265 gpm increases operation to 240 per cent of rated capacity. This difference in flow rate is largely responsible for the discrepancies in peak turbidities obtained with the two units.

Turbidities from the sludge-blanket unit show the effects of a rate of operation during backwash nearly double that at which the conventional unit operates.

The total turbidities obtained from each unit during backwashing have been "prorated" over this entire interval. Thus the broken curves in Fig. 5 represent the average increase in turbidity obtained if the turbidity discharged during backwashing were uniformly distributed throughout the periods of observation.

Filter Loadings

Though the frequency of backwashing filters is most often determined by the maximum pressure drop allowable across the filter, such is not the case at Firestone. Inasmuch as the pressure-loss build-up is very slow and does not reach a large figure at this plant, a policy is maintained of backwashing periodically to insure keeping the filter media loose and free. However, it is most significant that, though the filters are backwashed before the pressure drop becomes excessive, experience has indicated it is advisable to backwash each of the filters in the conventional system twice per day, whereas the filter after the sludge-blanket softener, in order to maintain the same desirable loose bed characteristics, is backwashed but once each day.

Calculations of the actual quantities of turbidity per day that are being passed from these softeners include normal operating periods as well as periods when filter backwash water is returned to the softener. The turbidity passed to the filters each day (at approximately 50 per cent capacity operation) was 10 lb from the conventional unit. The sludge-blanket softener, on the other hand, passed only 2 lb when softening at the same per cent of capacity.

That the filter after the sludge-blanket softener is backwashed only half as frequently as each of those following the conventional system softener might well be expected in light of the above-mentioned turbidities.

Table III of filter pressure losses indicates the higher loss before backwash (after 12 hr operation) through the filters handling the conventional softener effluent in comparison with the loss before backwash of the filter treating sludge-blanket effluent over the longer 24 hr period. Thus, if the filters were washed in accordance with pressure loss, it is obvious that those treating conventional softener water would require backwashing much more frequently than the filter receiving sludge-blanket treated water.

Silica Removal

The extent of silica removal in a hot-process softener is determined by several factors, which include: the quantity of silica initially in the water; the concentration of magnesium hydroxide in contact with the raw water, and thus the amount of magnesium-oxide employed to effect the silica removal; the temperature in the softener; the pH of the water; and the contact time of water with magnesium hydroxide.

Contact time and concentration of magnesium hydroxide are of prime importance. In a sludge-blanket design softener, remarkably high concentrations and contact times are obtained as a natural consequence of passing water through this blanket. Somewhat similar benefits of contact time are obtained by recirculation in a conventional softener. However, the high localized concentrations of magnesium hydroxide which exist in a sludge-blanket are not equalled when recirculation is practiced.

The effects of varying concentrations and contact times of magnesium hydroxide and residual silica content are illustrated in Fig. 4.

The results of first increasing and then decreasing the depth (and volume) of the sludge-blanket and further maintaining other conditions

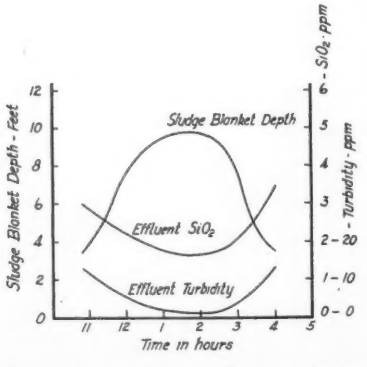


Fig. 4. Curves showing effects of sludge-blanket depth on silica removal and turbidity

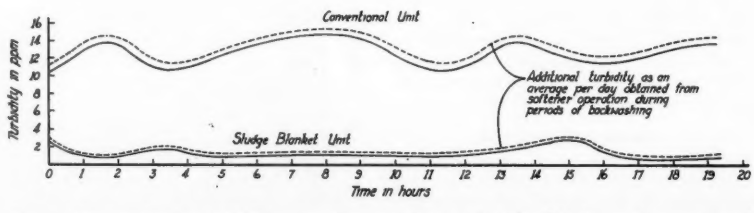

Turbidity in ppm
Conventional Unit
Additional turbidity as an average per day obtained from softener operation during periods of backwashing
Sludge Blanket Unit
Time in hours

Fig. 5. Curves showing turbidities in softener effluents of sludge-blanket and conventional units

TABLE III

Pressure Loss Through Filters

Time after conclusion of backwashing	Approximate Pressure Drops Filter Following Sludge-Blanket Unit	Filters Following Conventional Unit
1/4 hr.	0.5	0.5
1 1/2 hr.	0.5	1.0
5 hr.	0.5	1.0
8 1/2 hr.	1.0	1.5
12 hr.	1.0	3.5
24 hr.	1.0	Units backwashed each 12 hr.

TABLE IV

Silica Content of Treated Water Before and After Filtration

Conventional System			Sludge-Blanket System		
Before Filter	After Filter	Removed in Filter	Before Filter	After Filter	Removed in Filter
6.0 ppm	3.3 ppm	2.7 ppm	4.0 ppm	1.9 ppm	2.1 ppm
5.5 ppm	3.3 ppm	2.2 ppm	4.8 ppm	2.9 ppm	1.9 ppm
7.0 ppm	4.8 ppm	2.2 ppm	4.0 ppm	2.3 ppm	1.7 ppm
4.2 ppm	2.6 ppm	1.6 ppm	1.9 ppm	0.7 ppm	1.2 ppm
5.8 ppm	4.6 ppm	1.2 ppm	1.8 ppm	0.9 ppm	0.9 ppm

nearly constant, are a decrease in silica to 1.5 ppm in the effluent (with deep blanket) and a later increase to over 3 ppm silica (with reduced blanket). These results might well be anticipated by considering the various volumes of sludge-blanket present.

At Firestone the chemical Remosil (MgO) was applied to supplement the magnesium of the raw water precipitated as $Mg(OH)_2$ (due to the lime added for softening) in order to effect removal of silica. This was practiced in both hot-process units.

Tests to determine the effluent silica content with varying quantities of magnesia are shown graphically in Figs. 6 and 7.

The silica content of the water entering the softener is approximately 25 ppm at all times; due to use of several different wells at different times during the day, the magnesium content of the raw water may vary from 40 to 90 ppm as $CaCO_3$.

Thus to develop Figs. 6 and 7, analyses were made of the raw water to determine both silica content and magnesium content. With a knowledge of the raw water characteristics and by controlling the amount of Remosil fed to the softeners, it was possible to vary, as desired, the quantity of magnesia ($Mg(OH)_2$) available for silica reduction and to determine its effectiveness by measuring the silica content of the effluent.

Standard daily operation at this plant calls for an addition of 60 ppm MgO as $CaCO_3$ and thus the total magnesia normally available may vary from 100 to 150 ppm (as $CaCO_3$).

When operating within this particular range it may be seen from Fig. 6 that the silica content in the effluent from the sludge blanket system approximates 2 to 2.5 ppm whereas the conventional system operating without recirculation produces an effluent containing 4 to 5 ppm.

Comparative Silica Removal Results

In order to evaluate completely the above results as well as other results observed and described by Fig. 6, temperature differences in the units must be considered. The temperature in the conventional units averages 212 to 218 F, whereas the sludge-blanket unit operates usually at approximately 206 to 209 F. Even lower silica results may be expected from the sludge-blanket unit when operated at temperatures corresponding to those in the conventional unit. Smaller silica residuals may be expected from both softeners when operating at temperatures higher than those mentioned above.

Figure 7 describes the operation of the sludge-blanket unit, which at lower temperatures and increased Remosil dosages reduces the silica to approximately 1.6 ppm. With slightly increased temperatures, 214 to 217 F, the silica content was reduced to less than 1 ppm. The leveling of the curve indicates a condition of chemical equilibrium was approached at these points.

The conventional unit was effective in reducing silica to slightly more than 3 ppm (Fig. 6). This appeared to be a limited point for this unit and these operating conditions.

Inasmuch as recirculation may be employed for the re-use of the magnesium hydroxide and for increased contact time, it was practiced in the conventional unit in order to determine its value for silica reduction. As shown by curves of Fig. 6, silica removal was improved, but even recirculation did not reduce the silica to the low quantities measured in the sludge-blanket treated water for equal quantities of Remosil fed.

Close analysis of these systems indicated that the filters of both were effecting some slight silica reduction. This reduction was approximately 0.3 to 0.5 ppm greater in the filters of the conventional system and resulted from the higher turbidities carried over on to these filters, which in turn allowed additional contact time for the magnesia and the water undergoing treatment. It is seen from Table IV that the conventional softener received some additional assistance from the filters that followed it and thus its own activity in silica reduction must be considered somewhat lessened.

It is felt that the results exhibited by the sludge-blanket unit can logically be expected when consideration is given to principles governing silica removal and the design of this unit, which provides primarily for greater $Mg(OH)_2$ concentration.

Through an extended period of observation, the sludge-blanket unit, while operating under slightly less desirable conditions than the conventional, with or without recirculation, consistently produced water with the small silica content.

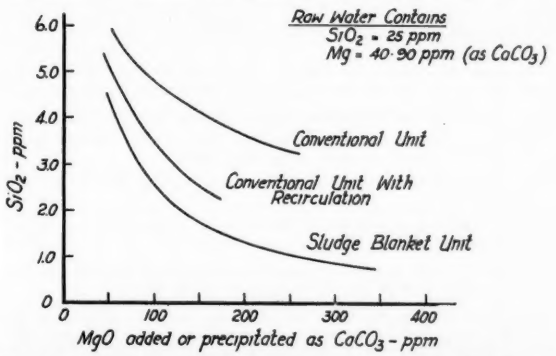

Raw Water Contains
SiO2 = 25 ppm
Mg = 40-90 ppm (as CaCO3)
Conventional Unit
Conventional Unit With Recirculation
Sludge Blanket Unit
SiO2 - ppm
MgO added or precipitated as CaCO3 - ppm

Fig. 6. Curves showing silica reduction results with application of varying quantities of magnesia

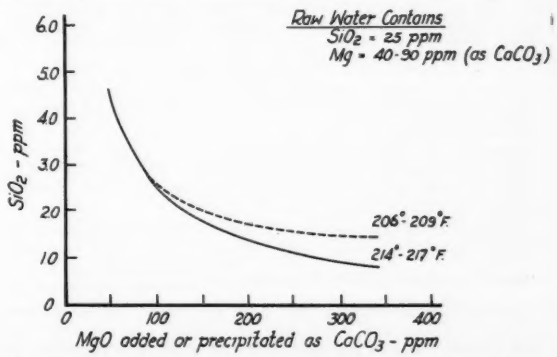


Fig. 7. Curves showing effect of temperature on silica reduction with magnesia on sludge-blanket softener

Basic Power Plant

FIGURING

A Review for Old-Timers—A Must for Young-Timers

By **WILLIAM H. ENGELMAN**, Mechanical Engineer, Department of Water & Light, City of Cleveland, Ohio

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Physical Characteristics of Schedule 80 Pipe, Needed in Practical Power Plant Problems

All the standard physical data on Schedule 80 pipe, collected on these two pages from standard tables in many handbooks and data books

Saves looking them up in a number of different tables

KEEP THESE TABLES. You will need them in solving problems coming in future Basic Power Plant Figuring articles

Table B — DATA ON SCHEDULE 80 PIPE. (Formerly Known as "Extra Strong" Pipe.)

Nom. Pipe Size In.	Outs. Dia. In. O.D.	Inside Dia. In. D.	Wall Thick-ness In.	Area of Metal Sq. In.	Weight Per Foot Lb.	Cross-Sectional Internal Area		Square Feet of Surface Per Linear Foot		Linear Foot Per Sq. Ft. of Surfaces		Capacity in G.P.M. at 1 Ft./Sec. Velocity	Lbs. Water Per Hour, at 62.4# Cu.Ft. Vel.=1 F.P.S.	Nom. Pipe Size In.
						Square Inches	Square Feet	Outs.	Ins.	Ext.	Int.			
	1	2	3	A 4	5	6	7	8	9	10	11	12	13	
1/8	0.405	0.215	0.095	0.0925	0.314	0.03631	0.000252	0.106	0.0563	9.431	17.766	0.11316	56.64	1/8
1/4	0.540	0.302	0.119	0.1574	0.535	0.07163	0.000497	0.141	0.0792	7.073	12.684	0.22327	111.75	1/4
3/8	0.675	0.423	0.126	0.2173	0.738	0.14053	0.000976	0.177	0.1110	5.658	9.030	0.43802	219.23	3/8
1/2	0.840	0.546	0.147	0.3200	1.087	0.23414	0.001626	0.220	0.1430	4.547	6.995	0.72979	365.26	1/2
3/4	1.050	0.742	0.154	0.4335	1.473	0.43241	0.003003	0.275	0.1942	3.637	5.147	1.34778	674.56	3/4
1	1.315	0.957	0.179	0.6388	2.171	0.71931	0.004995	0.344	0.2505	2.904	3.991	2.24200	1122.12	1
1 1/4	1.660	1.278	0.191	0.8815	3.000	1.28278	0.008908	0.435	0.335	2.301	2.988	3.99827	2001.13	1 1/4
1 1/2	1.900	1.500	0.200	1.068	3.631	1.76715	0.012272	0.498	0.393	2.010	2.546	5.50800	2756.75	1 1/2
2	2.375	1.939	0.218	1.477	5.022	2.95288	0.020506	0.622	0.508	1.608	1.969	9.20378	4606.49	2
2 1/2	2.875	2.323	0.276	2.254	7.66	4.23827	0.029432	0.753	0.609	1.328	1.644	13.21019	6611.70	2 1/2
3	3.500	2.900	0.300	3.016	10.25	6.60520	0.045870	0.917	0.760	1.091	1.317	20.58764	10304.11	3
3 1/2	4.000	3.364	0.318	3.68	12.51	8.88796	0.061722	1.047	0.882	0.954	1.135	27.70273	13865.22	3 1/2
4	4.500	3.826	0.337	4.41	14.98	11.4969	0.079840	1.178	1.002	0.848	1.000	35.8344	17935	4
5	5.563	4.813	0.375	6.11	20.78	18.1937	0.126345	1.456	1.263	0.686	0.793	56.7077	28382	5
6	6.625	5.761	0.432	8.40	28.57	26.0667	0.181019	1.734	1.510	0.576	0.663	81.2468	40664	6
8	8.625	7.625	0.500	12.76	43.39	45.6635	0.317108	2.258	2.000	0.443	0.500	142.3279	71235	8
10	10.75	9.564	0.593	18.91	64.40	71.8405	0.498892	2.817	2.503	0.355	0.395	223.9183	112071	10
12	12.75	11.376	0.687	26.03	88.60	101.6410	0.705841	3.340	2.980	0.299	0.336	316.8032	158560	12
14	14.0	12.500	0.750	31.22	107	122.7185	0.852212	3.665	3.28	0.273	0.305	382.4991	191441	14
16	16.0	14.314	0.843	40.14	137	160.9207	1.117505	4.189	3.76	0.239	0.266	501.5710	251036	16
18	18.0	16.126	0.937	50.23	171	204.2411	1.418341	4.712	4.23	0.212	0.236	636.5957	318616	18
20	20.0	17.938	1.031	61.44	209	252.7190	1.755000	5.236	4.70	0.191	0.213	787.6956	394242	20
24	24.0	21.564	1.218	87.17	297	365.2150	2.536215	6.283	5.65	0.159	0.177	1138.3322	569735	24

EXPLANATION AND USE OF VALUES IN TABLE

Pipes by "schedule numbers" introduced as tentative in 1935; approved and adopted in 1939 by the American Standards Association (ASA-B36.10). Pipe up to 12 in. diameter inclusive is designated by its nominal inside diameter, while pipe 14 in. and larger is designated by its outside diameter (O.D.). Wall thicknesses of 10-in. pipe and under and identical with those of standard weight pipe in former lists.

Designation of pipe wall by "schedule numbers" make the terms "standard," "extra strong" and "double extra strong" obsolete. Schedule number = 1000P /S, where: P = Internal pressure, psig; S = Allowable fiber stress, psi

Decimal thicknesses for the steel pipe sizes represent their nominal average wall dimensions and include an allowance for mill tolerance of 12.5 per cent under the nominal thicknesses.

The inside diameter functions of wrought iron pipe differ from the values for steel pipe given in this table, but the differences are well within the tolerances permitted with both kinds of pipe.

7. Square feet area is also volume in cubic feet per linear foot.
8. Square feet of outside surface per foot is also circumference in feet and square feet of heating surface.
10. 100 sq ft radiation with 2 in. pipe requires 100 × 1.608 = 160.8 lin ft.
12. Multiply value in table by the velocity in feet per second to get the discharge in gallons per minute.
13. Discharge in pounds of water per hour at 1 fps velocity is based on 62.4 lb per cu ft (Density at 52 F).
14. Cu ft flowing per min. × lin ft per cu ft = velocity in ft per min. Thus, 1,000 cu ft of steam or air per min through a 5 in. sched. 80 pipe gives a velocity of 1000 × 7.915 = 7915 ft per min.

HERE THE AUTHOR presents the second of a pair of the most unusual and helpful tables of pipe data we have seen, covering many of the physical dimensions and characteristics of Schedule 80 pipe, ASA-B36.10. In the July issue he offered a similar table for Schedule 40 pipe. These are the two you have most use for in 90 per cent of your power plant work, especially in industrial power plants.

For solving various practical problems in steam engineering, you need all the dimensions of pipe, columns 1 to 11. For calculating steam and water flows and velocities by various standard formulas, you need columns 12 to 16 and often 22 and 23. When you use pipe for structural purposes, then you need columns 17 to 21. Handy and practical for pipe layout man, as well as pipefitter, is column 25.

These articles on Basic Power Plant Figuring began in the February 1949 issue and will continue in each future issue. They are selected from the fundamental data and problem sheets used by Mr. Engelman in teaching his course in steam power plant engineering in Cleveland, Ohio. (See POWER GENERATION, Feb., 1949, page 82; and August issue, page 70.) Now that both pipe tables have been published, we will present some of the author's sheets on design of piping, figuring practical boiler, turbine, condenser and pumping problems, heat balance and so on. In figuring such problems, you will be referred back to these pipe tables for data, so SAVE THEM NOW —in file or notebook.

You should also save the page-size Mollier charts and the tables of engineering data and conversion factors published in the first five installments, for future articles will refer back to them also.

Next time:—Flow of Steam and Water in Pipes — Typical Power Plant Steam Header Problem

Table B — DATA ON SCHEDULE 80 PIPE (Continued)

Nom. Pipe Size In.	Linear Feet to Hold: One Cubic Ft.	Linear Feet to Hold: One Gallon	Lb. Wat. Per Lin. Ft. at 62.4# Per Cu. Ft.	Pipe Column at 15,000 Psi.: Maximum Load, Lb.	Pipe Column at 15,000 Psi.: Length Feet	Elements of Pipe: Moment of Inertia	Elements of Pipe: Section Modulus	Elements of Pipe: Radius of Gyr'n. Squared	Internal Diameter to the: 5.0 Power $=D^{5.0}$	Internal Diameter to the: 2.5 Power $=D^{2.5}$	Allow. Press. at 650 F	Thr'd for Tight Joint	Nom. Pipe Size In.
	14	15	16	17	18	19	20	$=\frac{}{R^2}$ 21	22	23	24	25	
1/8	3966.37	530.230	0.0157	1390	0.7	0.00122	0.00600	0.01314	0.00046	0.02143	Grade	1/4"	1/8
1/4	2010.30	268.737	0.0310	2360	0.9	0.00378	0.01395	0.02393	0.00251	0.05012	"A"	5/16"	1/4
3/8	1024.69	136.981	0.0609	3260	1.1	0.00862	0.02554	0.03400	0.01354	0.11637	Pipe	3/8"	3/8
1/2	615.01	82.216	0.1015	4800	1.3	0.02010	0.04780	0.06273	0.04852	0.22028		1/2"	1/2
3/4	333.02	44.517	0.1874	6500	1.5	0.04479	0.08531	0.10330	0.22492	0.47425	1550	9/16"	3/4
1	200.19	26.762	0.3117	9600	1.9	0.10560	0.16060	0.16531	0.80271	0.89594	1560	5/8"	1
1 1/4	112.26	15.0065	0.5559	13200	2.5	0.2418	0.2913	0.2743	3.409	1.8422	1180	13/16"	1 1/4
1 1/2	81.49	10.8933	0.7658	16000	3.2	0.3912	0.4118	0.3663	7.594	2.7557	1110	3/4"	1 1/2
2	48.77	6.5191	1.2796	22150	4.0	0.8679	0.7309	0.5875	27.409	5.2353	1020	7/8"	2
2 1/2	33.98	4.5420	1.8366	33800	5.0	1.924	1.3390	0.8539	67.646	8.2248	1180	1"	2 1/2
3	21.80	2.9144	2.8623	45250	6.0	3.892	2.2251	1.2910	205.115	14.3220	1085	1 1/16"	3
3 1/2	16.20	2.1658	3.8515	55200	7.0	6.280	3.1402	1.7070	430.804	20.7560	1020	1 1/8"	3 1/2
4	12.525	1.6744	4.9820	66150	8.0	9.61	4.27	2.18	819.8	28.633	981		4
5	7.915	1.0581	7.8840	91650	10.0	20.67	7.43	3.38	2582.7	50.821	908		5
6	5.524	0.7385	11.2955	126000	12.0	40.49	12.22	4.82	6345.8	79.661	907		6
8	3.154	0.4216	19.7875	191400	14.0	105.7	24.51	8.28	25775.0	160.546	829		8
10	2.004	0.2680	31.1309	284000	16.0	244.9	45.56	12.94	80020.0	282.878	811		10
12	1.417	0.1894	44.0444	390000	18.0	475.2	74.60	18.25	190523.0	436.490	807		12
14	1.1734	0.15686	53.178			687.5	98.2	22.02	305176	552.37	811		14
16	0.8949	0.11962	69.732			1156.6	144.6	28.81	600904	775.18	807		16
18	0.7050	0.09425	88.505			1833.9	203.8	36.50	1090518	1044.28	805		18
20	0.5698	0.07617	109.512			2771.0	277.1	45.11	1857250	1362.80	804		20
24	0.3943	0.05271	158.260			5673.0	472.8	65.06	4662800	2159.40	800		24

EXPLANATION AND USE OF VALUES IN TABLE

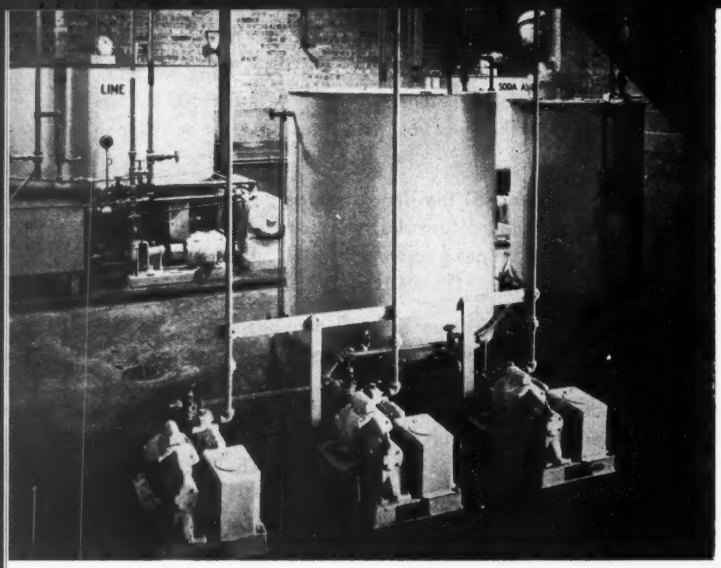
15. Gallons of liquid flowing per min × lin ft per cu ft = velocity in ft per min. Thus, 375 gpm flowing through a 5 in. schedule 80 pipe = 375 × 1.0581 = 397 ft per min.

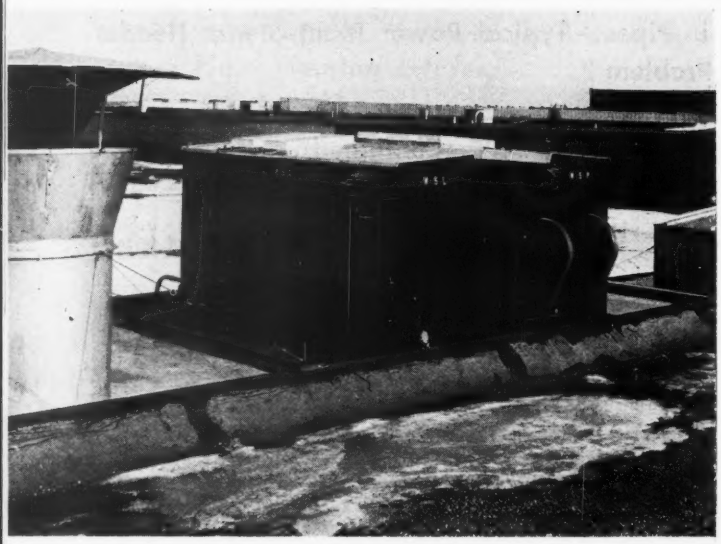
19. Moment of inertia = Item 4 × Item 21 = $AR^2 = 0.0491\ (O.D.^4 - D^4)$.

20. Section modulus × fiber stress = bending moment = M_b.

23. Values of inside pipe diameter to the 2.5 power are the direct ratios of their relative discharge capacities; area only for comparing capacities is misleading and wrong, see the example: How many 2 in. pipes are required to equal the discharge of a 5 in. pipe?
$4.813^{2.5} = 50.821$; $1.939^{2.5} = 5.2353$, and $50.821 \div 5.2353 = 9.7$ — 2 in. pipes.
Area only: $18.1937 \div 2.9529 = 6.16$ — 2 in. pipes to equal one 5 in. pipe.
Discharge capacity = $9.7 \div 6.16 = 1.574$ or 57.4% more than by area.

24. Allowable working pressure at 650 F for Grade "A" seamless steel piping, ASTM specification A-106, covering power piping and district heating systems. The minimum ultimate strength in tension is 48,000 psi which gives a working strength of 9600 psi at 650 F, the base for the tabular values. For lower steam temperatures values listed for 650 F must be used. For Grade "B" seamless steel piping multiply values in table by 1.25, since Grade "B" is somewhat stronger than Grade "A." General practice limits the use of schedule 80 pipe to a steam pressure of 800 psig at 650 F (Grade "A" pipe) and 1000 psig at 650 F for grade "B" pipe.





Steam and

TO MEET the demands arising from rapid expansion in use of Diesel locomotives by American railroads, great increases have been necessary in the facilities of Electro-Motive Division of General Motors Corp at LaGrange, Illinois, one of the principal manufacturers of such locomotives. Beginning in 1936 with a building of approximately 250,000 sq ft of floor space, the LaGrange plant has now grown into the largest plant in the world devoted solely to Diesel locomotive production. It now has three buildings with a total of over 3,000,000 sq ft.

To provide steam for this greatly expanded plant, a new steam plant has recently been completed, as shown in the accompanying views. The electrical distribution system, for which all power is purchased from the local utility, has also been greatly expanded; total demand load is now over 13,000 kva.

Fig. 1. (Upper Left) View of chemical mixing room of new steam plant. Main chemical mixing tanks for lime and soda ash in background. Proportioning pumps and the tanks in foreground are for secondary treatment using phosphate and organic colloids. Lime and soda ash tanks are cross-connected so that either unit may be used for complete treatment, with the other unit out of service for maintenance

Fig. 2. (Left Center) View of one of several air-cooled 12 000/480-v, a-c unit sub-stations on roof of main manufacturing building. Power bank is rated at 1000 kva and lighting bank at 300 kva. Large duct in background is used for reclaiming waste heat from Diesel test floor to heat main manufacturing area

Fig. 3. (Below) View on main firing floor of new steam plant showing two steam-turbine-driven boiler feed pumps. In right background is the 125-kva, 480-v steam-turbine-driven alternator for emergency power

Power for Electro-Motive

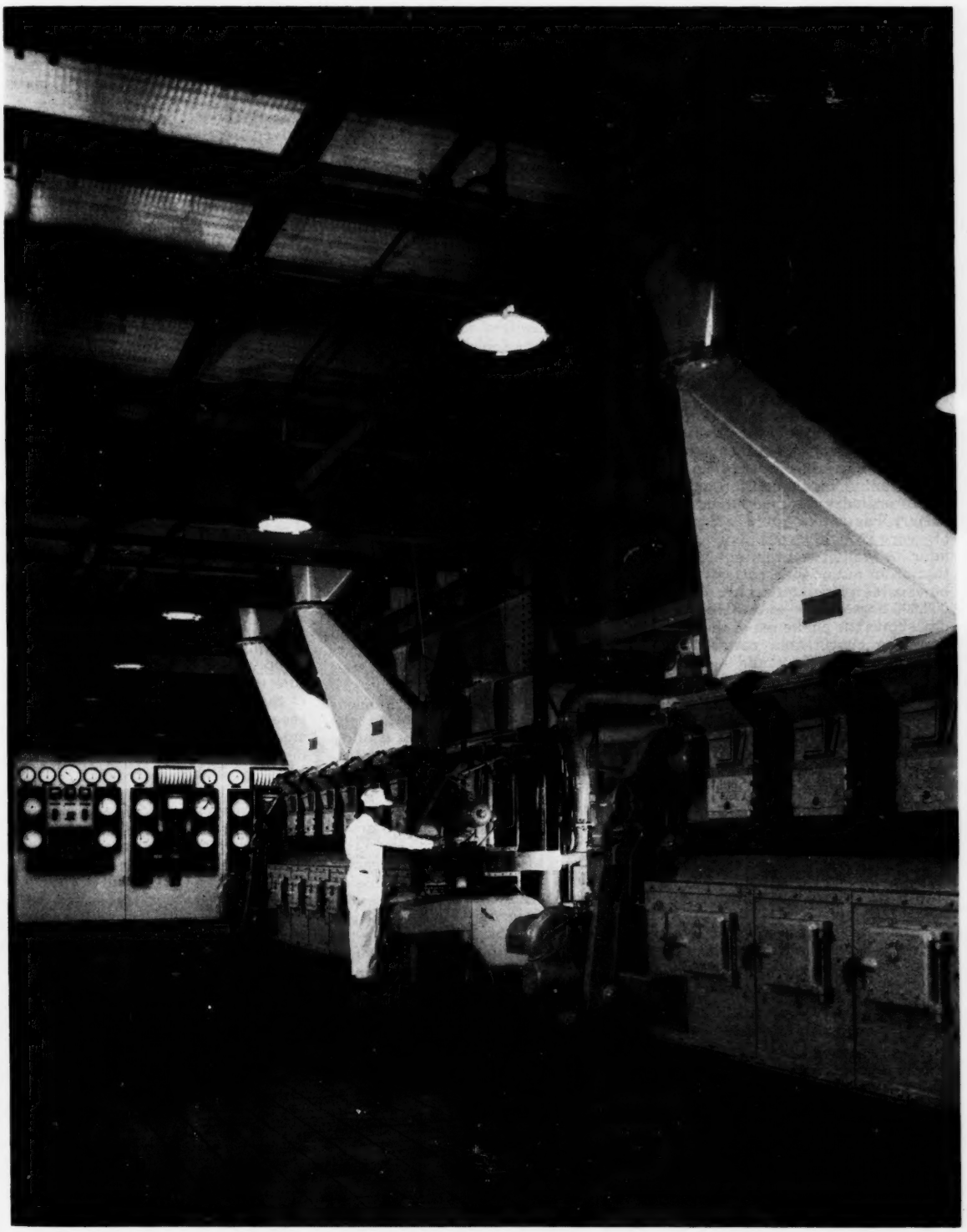


Fig. 4. View of main firing aisle of Electro-Motive's new steam plant. Two boilers are rated at 150,000 lb of steam per hour each, at 150 psig and 50 F superheat. These are fired by spreader type stokers with continuous ash discharge. Combustion control and metering panels in background

ATOMICS

Atomic Power and Its Implication for Aircraft Propulsion*

By LAWRENCE R. HAFSTAD,
Director of Reactor Development
United States Atomic Energy Commission

REACTORS are the machines for giving us the controlled release of nuclear energy, and as such, certainly have promise for both peace and for war. Such reactors have inherent in them the possibility of providing an incredibly compact power unit, one that would be of immense value in aircraft propulsion.

An ordinary automobile storage battery has a total storage capacity of, very roughly, one horsepower hour. A weight of uranium equal to that of an automobile battery would be capable of delivering about 300,000,000 horsepower hours. This analogy shows the challenge of the problem, the conceivable rewards—the "pie in the sky." It would seem that the possibility of nuclear reactors for power production must at least be explored.

If these reactors are so desirable for the production of power, why don't we go ahead and build some? Here we come to the difficulties! Here are a few of them:

1. That for any reasonable thermodynamic efficiency in utilizing the great energies available, it is necessary to operate at temperatures well above the conventional engineering range.

2. The compactness of reactors, which is an important advantage, proves troublesome in regard to the heat transfer problems which involve heat transfer rates far above those used in practice.

3. The materials chosen for reactor construction must withstand not only the high temperatures but also high nuclear radiation densities, with unpredictable changes in the physical properties of the materials concerned. The seriousness of this problem can be visualized by a kind of a comparison. How would you like, for example, to design airplanes or engines if, in use, the properties of the aluminum and steel would gradually change to those of cast iron or lead?

4. If we finally find a structural material for reactors which appears suitable so far as physical properties are concerned, we must now add still another requirement. The nuclear properties must be such that the structural material must not capture neutrons and thus deplete the supply and reduce the power. This requirement drives us to consider strange new elements, and raises a whole array of procurement problems.

5. Even after we have our reactor working we find that the fission products produces as an essential part of the reaction "poison" the reaction itself. The ashes smother the fire. In aircraft operation, most of us are aware of the enormous maintenance problems for aircraft engines. Every 800 hours they must be disassembled, inspected, have defective parts replaced, and then reassembled and tested. The work is staggering. Suppose, however, that instead of merely disassembling, the entire engine would have to be dissolved in nitric acid, and then completely rebuilt, starting with a solution of certified, chemically pure iron? This is the fuel reprocessing problem.

6. Finally, assuming we have solved the structural problems listed above, we have a whole new catagory of problems in connection with the working fluid or heat transfer medium used to convert the heat into power. The nature of these problems can be suggested by the fact that from rough comparisons of the volumes of reactors and the present highly perfected aircraft engines, the rates of heat transfer must be far greater for nuclear reactors than for conventional engines. Orthodox advances will not be sufficient. The problems involve the use of liquid metals with all the associated corrosion, erosion, purification and pumping troubles.

In the application of nuclear energy to aircraft propulsion the NEPA project, carried out by the Fairchild Co., under an Air Force contract, has been engaged in a vigorous attack on this problem since 1945. As seems to be characteristic of this field of activity, anything which is obviously desirable and important seems to be almost incredibly difficult. To help solve these problems the Commission, last year, made a contract with the Massachusetts Institute of Technology to make a study of the problems and to come up with recommendations. The result of this study was the Lexington Report, the details of which at present are quite properly highly classified.

* This article is an abstract of an article in the August issue of ATOMICS magazine.

As previously announced, the ATOMICS section which previously appeared as a section of Power Generation since October 1945, is now being published as a separate new publication.

The new ATOMICS represents a greatly expanded service to those who are interested in the theory and applications of nuclear energy. It will keep readers abreast of what is happening in the field of atomic power development, in the industrial applications of radioactive isotopes, and in the use of nuclear energy in medicine, biology and agriculture. The August issue, in addition to the article abstracted on this page, contains other material on atomic energy of general interest, including the third installment of the course in Nuclear Power Engineering which was started in the June issue.

If you are interested in seeing this new magazine regularly, send in the attached coupon for a free copy of the June issue. ATOMICS will be published monthly, and as has been true of the articles which appeared in the ATOMICS section of Power Generation, the articles will be kept on a practical understandable level.

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Questions and Answers

Q & A—THE POWER ENGINEER'S FORUM—HERE'S HOW IT WORKS

YOU HAVE a question about some detail of power plant operation, maintenance, design. You can't find the answer in your own experience nor in the books. So you write in to our editors. If we know the answer, we send it right back to you. (Maybe we don't know the answer either, but we usually know where to get it for you.)

In any case, we publish your question, signed only with your initials. We do not reveal your identity.

Dozens of engineers write in to us, giving their answers. We forward you copies of the replies as soon as we get them.

You, too, co-operate with other engineers by answering their published questions in the same way.

Then, so far as space permits, we publish those replies as soon as possible, so that everybody will learn what the others know about the problem. We pay well for all answers published. And those who answer get credit for knowing.

Simple, isn't it? And effective? Just ask the power engineer who has tried it!

Engineers who take the trouble to answer your question would appreciate some information from you, transmitted through the Q & A editor, on how their answers helped solve your problem. In doing this, indicate whether or not your comments could be published for the benefit of all readers.

Question No. 449

WHAT OPERATING DATA SHOULD BE LOGGED FOR A 1250-kw CONDENSING TURBINE GENERATOR?

WE HAVE A problem of working out a daily operating log for all readings for a 1250-kw condensing turbine generator with controlled extraction.

We have prepared a list of possible readings that may be taken on this unit. However, the general practice in power plants may not require so many readings taken every hour.

We are, therefore, looking for the ideas and opinions of engineers whose experience would enable them to provide a reasonable log form for this unit and be recognized as a reliable source of information.

Any information and typical log sheets for such a turbine that Q & A readers can supply will help us very much.

R. B. D.

Answer No. 442

HOW MUCH PHASE UNBALANCE CAN A GENERATOR STAND?

ON AN 1875-kva, 1500-kw, 3600-rpm, 2400-v, 60-cycle a-c generator, said A.R.E. in the June issue, he noted the following phase ammeter readings: Phase 1, 500 amp; Phase 2, 300 amp; Phase 3, 500 amp. The nameplate rated the machine for 451 amp per phase.

The above condition often continued for several hours, sometimes for several days. One engineer said it would do no harm; another said the unbalance should never be permitted above 10 per cent, also advocated a differential relay to trip the machine when the unbalance exceeds 10 per cent.

Will this condition harm the generator, asked A.R.E.? How much unbalance can any generator stand and for how long?

In the August issue, C. O. von Dannenberg agreed that the generator should not be operated continuously at more than 10 per cent unbalance and explained how this unbalance causes eddy currents to overheat the rotor, which may lead to mechanical failure. He referred to curves developed by manufacturers of generators to indicate allowable unbalance.

Sydney E. Bourne also discussed the heating effects caused by the phase unbalance and said the only sure way of telling if the unbalance will be detrimental is to check the temperature. If the machine does not have a hot-spot temperature indicator, he said, the over-all temperature rise should be held about 5 C below the rated rise of the machine. He also held that it is overload, not unbalance, that is the villain in the plot.

In all comments on this question, answerers have advocated consultation with the manufacturer of the particular machine. Certainly no one is in a better position to answer this question than the manufacturer. Hence it is a pleasure to present below a further comment by one of the engineers of a leading generator manufacturer. He shows first the curves of current ratios that Mr. von Dannenberg refers to, explains the action of the eddy currents, and

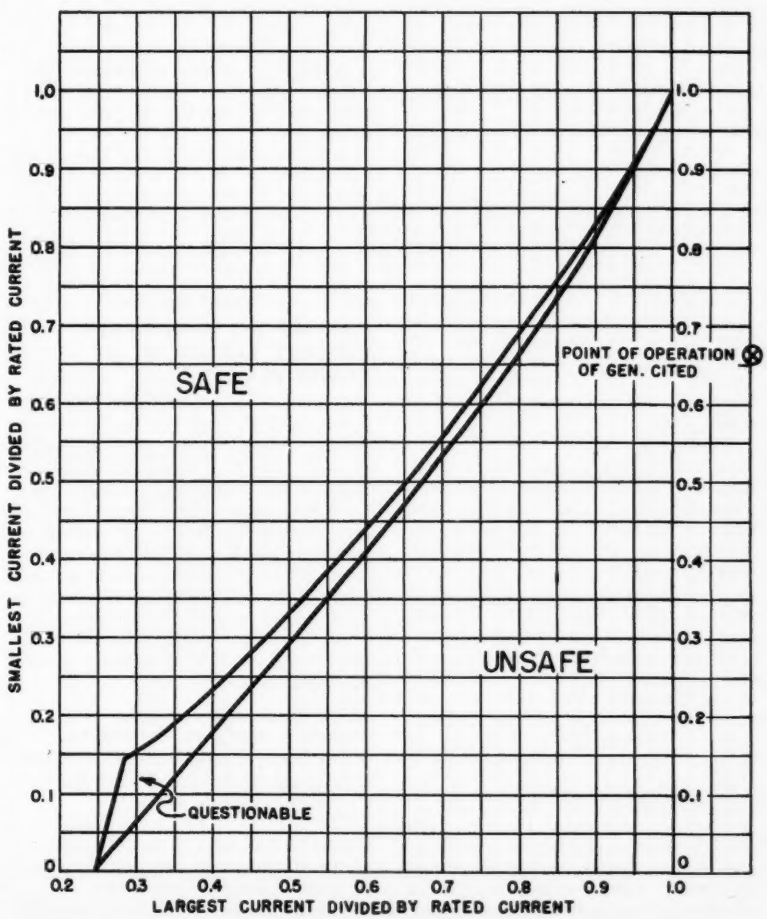


Fig. 1. Curves to indicate allowable unbalance of currents in turbine generators (E. J. Carraro, General Electric Co.)

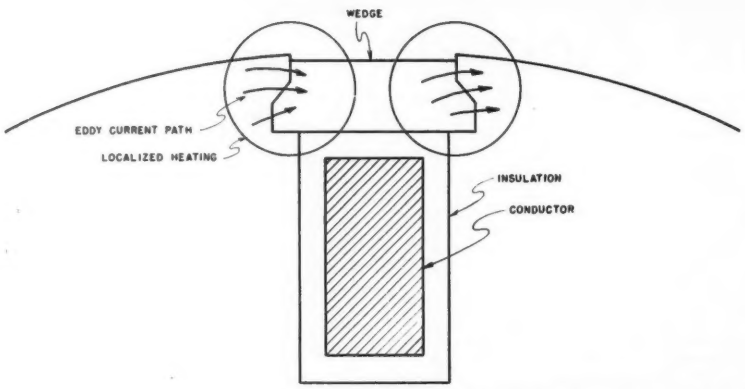


Fig. 2. Points of localized heating in generator rotor, caused by eddy currents produced by phase unbalance

gives comments on the use of a differential relay. Gentlemen, hear Mr. Carraro.

How Manufacturer's Curves Show Safe and Unsafe Conditions

CONDITION of operation of the turbine generator, as outlined in A.R.E.'s question, may be injurious to the generator.

Allowable unbalance of armature currents may be approximated from Fig. 1. This chart was made for new 3600-rpm generators of one manufacturer's design, but provides a fair estimate of the normal field of operation for any 3600-rpm generator in the size range of 500 to 10,000 kw.

Figure 1 shows three areas of operation possible with phase unbalance. To locate the area in which the generator is operating when loaded as described in the question, the procedure is as follows:

$$\frac{\text{Largest current}}{\text{Rated current}} = \frac{500}{451} = 1.109$$

$$\frac{\text{Smallest current}}{\text{Rated current}} = \frac{300}{451} = 0.667$$

Locating the intersection of these two amounts on Fig. 1 shows that the generator is operating in the "unsafe" region. A similar curve could be obtained for A.R.E.'s generator from the manufacturer of the equipment.

To answer A.R.E.'s second question, unsafe phase unbalance loading of generators may cause complete electrical failure and possible physical damage to the generator.

Operation with phase unbalance produces eddy currents on the surface of the rotor and in the rotor wedges. The magnitude of these eddy currents depends upon the unbalance between the phase currents and the amount of the individual phase currents. The flow of eddy currents across the path of high resistance between the rotor teeth and wedges that hold the field coils in place will cause localized heating. The amount of heat generated can vary from the "safe" to very "unsafe" amounts. This heat can damage the insulation of the field coils and may even soften the metal at these localized points, causing stresses beyond the limits of the material. Figure 2 shows these points of localized heating.

The differential relay would not be effective in protecting against unbalanced phase loading. This type of relay responds to faults which occur only within the generator and limited to individual phases.

Installing a limiting device which would limit the phase unbalance to 10 per cent, or any other set absolute figure, by tripping the generator, would not offer the proper protection and might unnecessarily restrict unbalance loading. The allowable ratio of the smallest current to the largest current, as obtained from Fig. 1, varies from zero to 100 per cent. Therefore, it would not be suitable to say that a specific ratio figure could be considered a maximum throughout the range of operation.

It is recommended that the phase unbalance in A.R.E.'s generator be restricted to the safe area of Fig. 1 as defined by the manufacturer.

West Lynn, Mass. E. T. CARRARO
Lynn Turbine & Gear Sales Division
General Electric Co.

Answer No. 444

CAN WE USE A CADMIUM STORAGE BATTERY IN A POWER PLANT?

ASKING this question in the July issue, W.J.S. referred to a recent article on the battery in Readers Digest, which intimated that the battery has been successfully used in Europe for some time but has been withheld from the American market. He asked for information about it, name of manufacturer and comments on possibility of using it as a power station battery.

As might have been expected, our old friend von Dannenberg comes through as follows.

Performance and economics still Uncertain, says von Dannenberg

THE QUESTIONER should present this problem to the Nicad Battery Co., Southampton, Mass.

The article in Reader's Digest referred to has lead to many inquiries about this type of battery and lack of information still continues.

The performance of the battery is still to be definitely determined for station application and there still remain the factors of economic consideration. If the installation is essentially for use as a control battery, the increased cost of the nickel-cadmium type over the generally used lead type may not be a limiting consideration.

Granting the life may be longer, we have many lead-type battery installations in operation over 15 years and one on record of 25 years plus. It is, of course, clear that the care and maintenance of a lead-type battery is a major factor in its performance and life. There are other factors too, like performance at lower temperatures, which should be taken into consideration for this newer type of battery.

C. O. VON DANNENBERG
Brooklyn, N. Y.

Answer No. 445

WHAT TREATMENTS PREVENT SCALE AND CORROSION IN DRINKING WATER SYSTEMS?

BECAUSE of his failure to find much in the power engineering field on the above question, J.W.B. asked in the July issue what treatments or materials can be purchased on the open market and used for such purposes without patent infringement? How about oxygen removal? Can sodium sulfite be used for that in drinking water systems and if so, what concentration? How about sodium tetraphosphate available on the open market?

We referred him to sources of information in the chemical and water supply fields.

Here are comments from Grant, who has previously offered us much good information on water treatment.

General Procedures and comments on Specific Chemicals by Grant

I CERTAINLY wish that J.W.B. had included an analysis of his water, that is, calcium carbonate content, hardness and pH value. Not knowing these, will try. There are several methods you may use, but first let us start at the cause.

Iron is somewhat soluble in water and most supplies will carry some in solution—that is, if the water isn't kept from coming in contact with the iron used in the distribution systems. The pH value of the water plays an important part, in this way: the lower the pH value, (higher acidity) the more iron will be dissolved than in the higher pH brackets. A pH of 6.0 or 6.5 dissolves appreciable quantities, while water with a 9.0 reading dissolves only a trace. As this action is carried on by the water, pits are formed in the pipe, with corrosion and "red water" as a result.

LETTERS TO THE EDITORS

(Continued from page 53)

This condition can be prevented by adjusting the chemical balance of your water system. Water can be treated so a protective film will coat the pipe interior, preventing the water from coming in contact with the iron. Water that has a saturated calcium carbonate content will coat these pipes and absorb the carbon dioxide (CO_2) in the water. However, the solubility of calcium carbonate depends on the carbon dioxide content. Water that is undersaturated with calcium carbonate will have the tendency to dissolve any protective coating and allow your present condition to exist.

I would next make an analysis of my water and refer to a water textbook, use the factors and determine a chemical balance, in ppm (parts per million). Use discretion and don't overdose at the start and don't continue any longer than it takes to accomplish the desired results. This building-up process has been known to "clog" pipes if overdone. If your calcium carbonate content is less than 25 ppm lime may be added to build up your $CaCO_3$. If the supply contains more than 25 ppm $CaCo_3$, soda ash may be used. Soda ash reacts with calcium sulphate to form calcium carbonate.

After this is done then check up on your pH and get that regulated. In this type of treatment, your calcium carbonate balance test is your friend, so don't be afraid to use it.

(Editor's Note:—Detailed instructions for these tests were given by E. O. Davis, *Power Plant Engineering*, October, 1945.)

Sodium hexametaphosphate, or "Calgon" may be added to a supply before it enters storage tanks or reservoirs. A small part of soda ash may be used at the same time to regulate pH. From experience, this is a rather effective means of treating large amounts of water that would make lime treatment impractical. This chemical may be dissolved in a pressure feeder and introduced into the intake line. The manufacturer would be very glad to assist you in computing the required dosage. Here are answers to your specific questions:

Question 1. I understand a masonite composition pipe is now on the market that might be used.

Question 2. Deactivators or deaerating heaters are the only methods this writer knows and doesn't believe the results would be worth the tremendous expense involved in this case.

Question 3. Sodium sulphite is used mostly as a safety measure in high-pressure boiler operation to absorb any residual O_2 not taken out by heaters. I believe this would cause an objectionable taste and a tremendous expense.

Question 4. This chemical is beyond the writer's scope. Let's hear from someone else on this one.

Danville, Ill. JOHN A. GRANT

currents will add directly in the neutral.

The harmonic currents circulating in the neutral are also likely to be somewhat higher in magnitude than the line-to-line harmonic currents. Since the third harmonic voltage is usually higher than any other and because the zero-sequence reactance is usually lower than the negative-sequence reactance, the effect of the high neutral current will be to trip the ground relay, although normal current is flowing in the three lines.

Solid grounding of generator neutrals is also dangerous since they will produce ground fault currents exceeding the three-phase fault current.

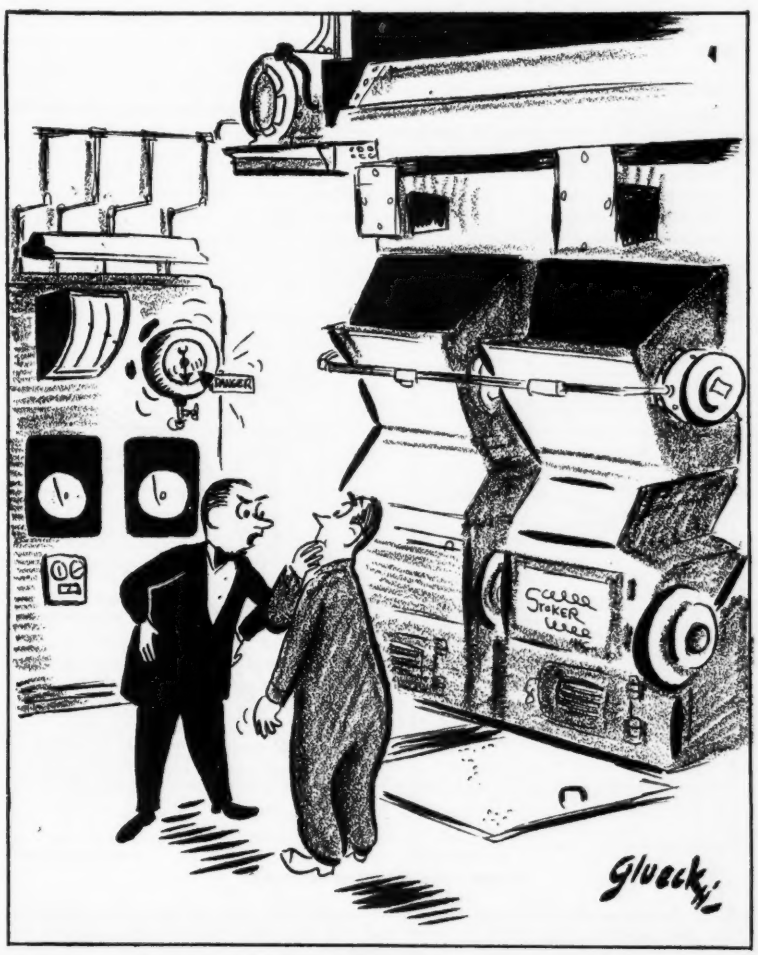
In general practice, both alternators are grounded through a low resistance or reactance; although with reactance there is danger, under some conditions, of producing harmful oscilations. Solid grounding of only one alternator is also a very good practice, doing away with the trouble caused by triple-frequency currents in the neutral and at the same time giving full protection to the system.

SERGIO MARTINEZ
Bauta, Habana, Cuba

HOW TO KEEP SOLDERING IRON HEAT WHERE IT BELONGS—AT THE TIP

RADIATION of heat from soldering irons can be prevented by painting the metal parts of the soldering, iron, other than the actual soldering tip, with a wash made from graphite and water. This will prevent radiation from any point where heat is not wanted. It will also make soldering less hot and uncomfortable. It can also be used to paint round a part that is to be soldered and from which it is desired to prevent radiation.

W. E. WARNER



"Always something new! What do you want with an over-temperature alarm?"

Vaporization Cooling of Large Electrical Machines

Discussion of the article on Vaporization Cooling of Electrical Machines by Theodore de Koning in the May issue of Power Generation. Here, the comments of two authorities in the field of electrical machinery cooling are presented together with a closing statement by Mr. De Koning

IN THE May issue of POWER GENERATION we presented an abstract of a paper on Vaporization Cooling of Large Electrical Machines, which had been presented before the American Institute of Electrical Engineers by Theodore de Koning of Philadelphia. This paper described a radically new method of cooling—one involving the vaporization of liquids at low pressures. Since the presentation of this paper provoked considerable discussion at the winter meeting of the A.I.E.E., we felt it desirable to publish it in POWER GENERATION, for two main reasons: first it gives the readers of POWER GENERATION, who may not have convenient access to A.I.E.E. literature, the benefit of a new idea in electric machinery cooling; and second, it provokes comments as to the merits of this new system.

Among a number of letters we have received as a result of the publication of this article, two rather comprehensive discussions of Mr. de Koning's paper are of particular interest since they come from men who are recognized authorities in the field of electric machinery cooling. These discussions are presented here; and since both of them are somewhat critical of Mr. de Koning's scheme, we have also asked Mr. de Koning for his final comments. The first of these discussions is by Carl Fechheimer of Milwaukee, Wisconsin. Mr. Fechheimer was for many years a specialist in the field of electric machinery cooling with Westinghouse Electric Corp. At present he is a consulting engineer in private practice. He is the author of many papers on electric machinery cooling and for many years has been recognized as one of the outstanding authorities in this field. Several years ago, he himself proposed a new method of cooling—one using liquid cooling in the rotors of large machines.

The second discussion is by D. S. Snell of the Generator Engineering Division of the General Electric Co. Mr. Snell also is an authority in the field of generator cooling and his detailed discussion of Mr. de Koning's scheme will be of interest to all who found the original article of interest.

In presenting these discussions we do so only with the thought that a free unbiased discussion of this subject will be of value to the engineering profession as a whole. As Mr. Snell points out, Mr. de Koning's paper is a provocative one, and if its conclusions are valid, could effect a major revolution in the design of electrical generating equipment. Both Mr. Fechheimer and Mr. Snell have their doubts as to the feasibilitl of Mr. de Koning's scheme.

Who is right, Mr. de Koning or his critics? We take no sides. de Koning's scheme is novel and revolutionary enough to deserve him to be heard. We presented his paper in the May issue; now we will see what Mr. Fechheimer and Mr. Snell think about the idea.

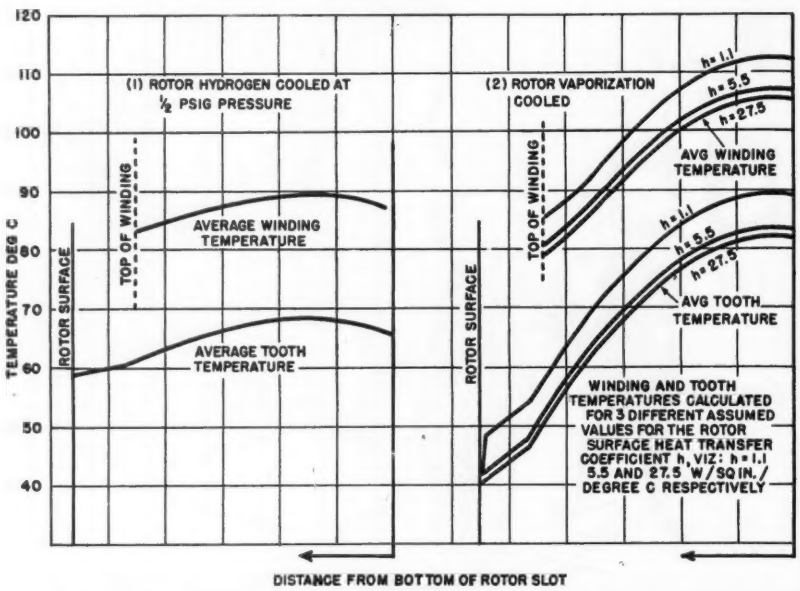


Fig. 1. Calculated distribution of temperature in slot and tooth of rotor of a 50,000 kw, 3600 rpm generator, operating at rated load, 0.8 pf. Two different rotor designs are considered:

(1) Rotor hydrogen cooled. Temperature of hydrogen leaving coolers 40 C. (2) Rotor designed for cooling by vaporization of water at 40 C on its air gap surface

DISCUSSION BY CARL FECHHEIMER

THE PAPER ON Vaporization Cooling by Mr. de Koning, in the May issue of "Electrical Engineering," and its abridgement in May POWER GENERATION, is of considerable interest. The editor of POWER GENERATION has invited further comment by readers. Following this invitation, I am therefore submitting herewith some considerations which were not brought out by de Koning, with the hope that they will assist the reader. This discussion pertains only to the removal of heat, and the consequent effect upon temperatures and ratings. No attempt is made to indicate what mechanical difficulties may arise.

The two major points in regard to cooling by vaporization are: (1) The removal of heat from the adjacent heated surfaces (that is, Heat Transfer). (2) The distances of such surfaces from the sources of heat generation. There are two other points which are important, but of less consequence than these two. They are: (3) The temperature of the ingoing coolant, and (4) the temperature rise of the coolant due to heat absorption.

Let us use the data as given by de Koning gives data for the re- that either of the two internal pressures of 0.8 or 1.6 psia can be maintained by pumping. Also, that in a 50,000 kva turbo alternator there are 2 per cent losses, or 1000 kw loss; that there are 25 hair tubes, each 5/64 in. internal diameter, through which water is supplied at the air gap, that the temperature rise of the evaporated water is 30 C, that the water vaporizes almost instantaneously after striking the heated rotor surface, etc.

Little is known about the heat transfer rate when a liquid impinges upon a heated cylindrical surface at a peripheral velocity of more than 300 mph and then vaporizes quickly. In order to have some estimate for calculation, suppose that the liquid leaves the hair tubes with sufficient velocity to strike the heated rotor surface, where it vaporizes and the vapor is driven away by centrifugal force. The heat transfer rate is reduced considerably below that which would obtain with the same fluid moving in a duct at the same velocity as that of the rotor's periphery. Plotting the data from Luke's paper[1] on log. log. paper, for a peripheral speed of 32,000 fpm (34 in. dia. at 3600 rpm), the heat transfer rate for air, under standard conditions, is about 0.153 watts per sq in. per deg C. But this rate may be considerably lower for water vapor at the low pressure considered.

An authoritative treatise on Heat Transfer is a book by McAdams: "Heat Transmission". In the second edition, page 168, the following equation is given for smooth ducts in which the flow is turbulent:

$$\frac{hD}{k} = 0.023\left(\frac{\rho DV}{\mu}\right)^{0.8}\left(\frac{C_p\mu}{k}\right)^{0.4}$$

h = heat transfer coefficient
D = equivalent diameter of the duct
k = thermal conductivity of the coolant
ρ = — mass density of the coolant
V = velocity of the coolant
μ = viscosity of the coolant
C_p = specific heat of the coolant at constant pressure

(The equation is written in this form because each of the groups is dimensionless, and each is named after an outstanding investigator.)

Note that, for a given duct size and velocity, the heat transfer rate "h" is proportional to

$$\rho^{0.8}\left(\frac{C_p}{\mu}\right)^{0.4} k^{0.6}$$

No doubt this relation is applicable to the air gap of a turbo also, assuming that only a comparison of the heat transfer rates of two cooling media is to be made. The properties of the two media (thermal conductivity, mass density, viscosity, and specific heat) were taken from published data in well-known tables. de Koning gives data for the reciprocals of the densities of water vapor at the two pressures considered. The comparison is made between air at normal sea-level pressure of 14.7 psi and at about 25 C and saturated water vapor at 0.8 and and 1.6 psi. The ratios of densities are 30.6 and 15.75 for 0.8 and 1.6 psia. These raised to the 0.8 power, give 15.44 and 9.074 respectively. Similarly, the ratio of specific heats is 0.5 and of viscosities 1.86. Then

$$\left(\frac{C_p}{\mu}\right)^{0.4} = 0.593$$

The conductivity ratio is about 1.3 and $1.3^{0.6}$ is 1.17. The product for 0.8 psi is 15.44 × 0.593 × 1.17 = 10.7, and for 1.6 psi it is 6.3. Thus, the heat transfer rate for air at one atmosphere is 10.7 (or 6.3) times that for water vapor at absolute pressures of 0.8 and 1.6 psi. Air is a poor medium for transferring heat, and low pressure saturated or superheated steam is considerably poorer.

With air cooling, the embedded rotor I^2R loss per sq in. of cylindrical surface is around 4.4 watts, which would give with the value from Luke, of 0.153 watts per sq in. per deg C a surface drop of 4.4/0.153 = 28.8 C. With water vapor, with the more favorable pressure of 1.6 psi absolute, this would become 28.8 × 6.3 = 182 C rise. With 0.8 psi it is 308 deg rise.

Suppose that the 25 hair tubes are uniformly distributed axially, and that the spray from each 5/64 in. tube spreads so as to be effective in cooling the rotor surface for about one inch axially. We shall go so far as to assume that this cooling is so effective that there is no increase in temperature for that one inch. If the body length axially is 115 in., the temperature rise of the rotor surface would be 182 × (115-25)/115 = 142 C with 1.6 psia.

For the stator, the surface temperature drop would also be high. In order to obtain the discharge axial velocity from the air gap of 60 mph given by de Koning, the pressure cannot be less than 1.6 psi and the flow must be directed toward both ends axially in the air gap. There is then a region near the middle axially where the axial component of the velocity approaches zero, and the cooling of the internal periphery can then be effected only by circumferential flow produced by the rotor. With the low density of the fluid, the so-called scrubbing action of the coolant is lowered materially, and the heat transfer coefficient is then around 1/6.3 times that for air, as computed above for the rotor. Consequently, here again there will be a high surface temperature, if the loss densities in the teeth and slots are comparable with those of present day large turbos.

Consider now number 2 in paragraph 2, the distance the heat must flow by conduction to the air gap, and the resultant temperature drop. An equation was derived for the tapered rotor teeth, considering that all of the I^2R is conducted tangentially through the insulating wall in the slots and then flows radially outward to the rotor surface. For the case where there are 4.4 watts per sq. in. of rotor surface, the temperature of the copper at the bottom of the slot is 37 deg higher than at the rotor surface. Suppose that 2/3 of the heat flows in the teeth and 1/3 radially in the copper, the drop then would be 2/3 of 37 or 24.4 deg.

In the stator the slots are deeper,

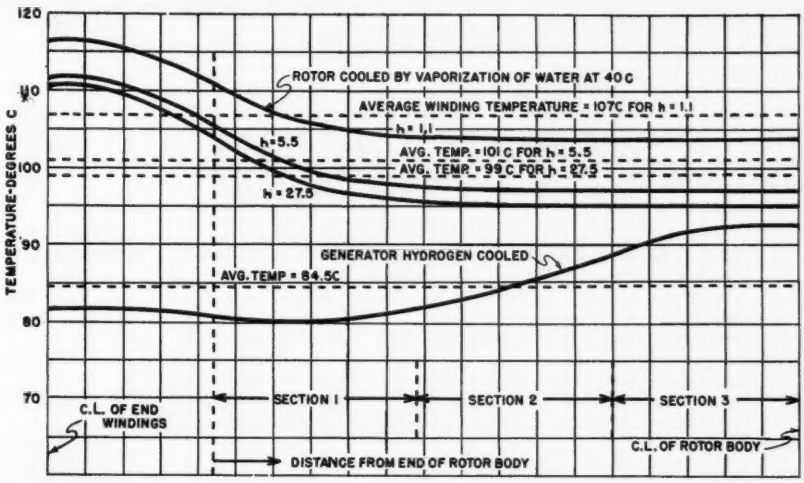


Fig. 2. Calculated axial distribution of temperature in rotor winding of a 50,000 kw, 3600 rpm generator operating at full load, 0.8 pf for two different types of rotor cooling (1) Generator ventilated with hydrogen at ½ psig. Temperature of gas entering fans, 40 C. (2) Rotor cooled by vaporization of water at 40 C on its outer surface. Temperatures calculated for 3 different assumed values for the rotor surface heat transfer coefficient h viz 1.1; and 27.5 W per sq in. per deg C respectively

[1] See paper by G. E. Luke (Cooling of Electric Machines), Transactions AIEE, page 646.

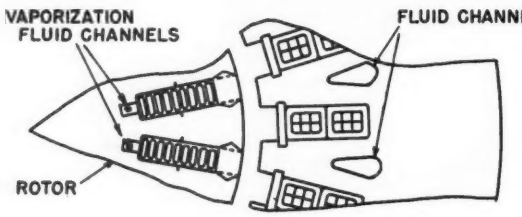


Fig. 3. Coil bottom cooling

and conditions are such as to produce a large radial drop. Although the stator copper is not worked as hard as the rotor copper, there are the iron losses in the teeth which augment the drop. Also, the teeth are narrowest adjacent to the air gap, where the density of heat flow is greatest, and the slots are usually deeper radially. de Koning is not clear how he would cool the stator core back of the slots. If an appreciable part of the core iron loss must flow inward to the air gap, the temperature drops in the teeth would become higher.

Consider now (3) and (4), the temperature of the ingoing coolant and its heat absorption. With 1.6 psi it is 47.3 C, which is higher than the usual reference ambient of 40 deg. With 0.8 psi the temperature is 34.2 C. This is lower, but with the considerably lower mass density of the vapor, the lower heat transfer rate and lower heat absorption rate, militate against the lower pressure. If the coolant temperature rise is 30 deg, at least ½ of this must be added to the ingoing coolant temperature. This heat absorbed is small compared with the heat of vaporization. At 1.6 psi and specific heat of 0.48 the Btu per pound is increased from 962.5 to 988.3, an increase of only 2.7 per cent. With the added temperature the volume increases 9.3 per cent.

The large turbos are crowded; it is, therefore, important to conserve space. Consequently, we are concerned with the Btu per *cubic foot*, rather than Btu per *pound*. To absorb 1000 kw with 1.6 psi and 30 deg rise for the coolant, the volume is 812,000 cu ft per hour. For air, based upon the reduced density corresponding to 30 C rise, it is 4 million cu ft per hr (not 40 million as given by de Koning). For water with the same conditions of 30 deg rise, only 1012 cu ft per hr would be needed which is only 0.123 per cent of 812,000 for water vapor.

To the above drops, the temperature drop across the slot insulating wall must be added. Based upon an insulation wall thickness of 0.0625 in. and thermal conductivity of the insulation of 0.003 watts per in. x deg C, this is about 36 deg. This is then reduced by 2/3 as for the radial drop, making it 24 deg.

Recapitulating, and using the lower figures as computed above, the total temperature of the rotor copper at the bottom of a slot, with 4.4 watts per sq in. of cylindrical surface is:

Drop at cylindrical surface	142 deg C
Radial drop	24 deg C
Mean temperature rise of coolant	15 deg C
Drop through slot insulating wall	24 deg C
Vaporizing temperature of coolant	47 deg C
Total	252 deg C

This temperature is prohibitive, and the rating would have to be reduced considerably.

DISCUSSION BY D. S. SNELL, Generator Eng. Div., G.E. Co.

THE PAPER BY Mr. de Koning is an interesting and provocative one, and if its conclusions are valid, could effect a major revolution in the design of electrical generating equipment. However, there are several factors which have not been considered in the paper, which, in my opinion make the use of vaporization cooling for large high speed machines of doubtful value. In the first place, it has not been proved by experiment that a cylinder rotating at high speed can be effectively cooled in the manner suggested in the paper, for the moderate temperature differences between surface and cooling medium that are available in electrical machines. While evaporative cooling from stationary surfaces at high temperature differences is known to be highly efficient, it has not been shown that such cooling is effective for rotating surfaces at moderate temperature differences.

However, granting for the moment that the heat transfer rates with evaporative cooling are as high as claimed by the author, this fact does not ensure that a rotor cooled by the vaporization of water on its outer surface will operate at a lower temperature than a rotor cooled by air or hydrogen, for the same load conditions. On the contrary, analysis indicates that the gas cooled rotor will operate at a lower temperature than the vapor cooled motor, since it can be cooled both from within and without, whereas the vapor cooled rotor must dissipate its entire heat loss from the outside cylindrical surface, which results in a high temperature drop in the rotor teeth. This increased temperature drop in the rotor iron more than offsets the reduced temperature drop at the rotor surface that may possibly be obtained through evaporative cooling.

This fact is demonstrated by an analysis which has been made of the heating of the rotor of a 2 pole 50,000 kw turbine generator operating at full load, first for the rotor cooled with hydrogen at ½ lb pressure, and second with the rotor cooled by evaporation of water at 40 C on its outer surface. The same rotor design and dimensions have been assumed in both cases, except that for the vapor cooled rotor the ventilating ducts in rotor body have been omitted; also, for the hydrogen cooled rotor the end windings are uninsulated except for the spacers between turns, while for the vapor cooled rotor the end windings are assumed to be insulated and encased in metal sheaths for conducting the generated heat to the retaining ring, where it may be dissipated by evaporative cooling applied to the outer ring surface.

For the hydrogen cooled rotor, surface heat transfer coefficients and thermal conductivities based on tests have been used. For the vapor cooled rotor an insulation conductivity about 12 per cent less than with hydrogen cooling has been assumed. Also, 3 different values for the surface heat transfer coefficient from rotor gap surface have been assumed, one based on experiment for water evaporating at 212 F from a stationary horizontal plate,[1] the other two values being 5 and 25 times this value, respectively.

The results of this analysis are given in Figs. 1 and 2, Fig. 1 showing the calculated radial temperature distribution in slot and tooth, Fig. 2 showing the calculated axial temperature distribution in the rotor winding, for the two types of rotor cooling. For the hydrogen cooled rotor the temperature of gas entering fans is assumed as 40 C; for the vaporization cooled rotor, a temperature of 40 C for the evaporating water at rotor surface is assumed.

Fig. 1 shows the calculated radial temperature distribution in slot and tooth for the two rotors. For the hydrogen cooled rotor, the temperatures have been calculated for three different sections of the rotor body, of about equal length, along the body length, and an average temperature curve for the 3 sections, for slot and tooth, is shown. For the vaporization cooled rotor, uniform axial temperature distribution along the body is assumed. The curves in Fig. 1 show that for the slot portion of the rotor the calculated winding temperature is appreciably higher for the vaporization-cooled rotor than for the hydrogen-cooled rotor, and that the radial temperature gradient in the winding is many times higher for the former than for the latter. This

[1] From Fig. 4 of ASME article "The Basic Laws and Data of Heat Transmission" by W. J. King, "Mechanical Engineering," August 1932, page 561.

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latter fact indicates that the winding of the vaporization-cooled rotor would be subjected to considerably greater temperature stresses in service, caused by expansions and contractions in starting-up and shutting down the unit, than the hydrogen-cooled rotor.

A comparison of the temperature curves for the vapor cooled rotor for 3 different assumed values of heat transfer coefficient, show that an increase of 5 to 1 for this coefficient reduces the calculated winding temperature by only 5 C, while a 25 to 1 increase in the h.t. coefficient raduces this temperature by only 7 C. This demonstrates that the temperature of the rotor winding with evaporative cooling is determined mainly by the temperature drops in the slot insulation and rotor teeth, rather than by the surface temperature drop, as has been assumed in the paper.

Figure 2 shows the calculated axial temperature distribution in the rotor winding for the 2 types of rotor cooling. For the vapor cooled rotor the axial temperature distribution in rotor body is shown to be more uniform than is obtained with hydrogen; however, the average temperature is higher, even for the highest assumed values for the heat tarnsfer coefficient. For the end windings the temperatures are from 30 to 35 C higher for the vapor cooled rotor than for the rotor hydrogen cooled. For the entire winding the calculated average temperature is from 99 to 107 C for the vapor cooled rotor as compared with 84.5 C for the hydrogen cooled rotor. Tests on a generator of this size under actual load conditions, with hydrogen cooling, gave a temperature rise for the field winding of 46 C above 40 C ingoing gas, which closely checks the calculated average value.

Mr. de Koning mentions the simplicity of the control equipment for the vaporization cooled generator as compared with the relatively complex control with hydrogen cooling. He neglects to note, however, the considerable progress toward simplification of the hydrogen equipment which has been made in recent years; also, in general the operation of the hydrogen equipment is not regarded by operators as complicated. Furthermore, a failure of the vaporization control equipment could in general have more serious consequences than failures of the hydrogen equipment, since the former could cause damage to the windings while the latter would usually require only that the unit be operated temporarily with air cooling at reduced load. Also, the ability of the hydrogen cooled generator to carry increased reactive load through an increase in the hydrogen pressure, gives hydrogen cooling a distinct advantage over other cooling means.

It is my opinion, therefore, based on the foregoing analysis and observations, that for turbine generators at least, vaporization cooling cannot be regarded as a serious competitor of hydrogen cooling, although there may possibly be some applications where vaporization cooling will prove valuable.

MR. DE KONING'S CLOSING REMARKS

I VALUE THE opportunity given to me to celar up several important matters. In the first part of this closure I will answer far reaching questions of a general nature put to me by interested engineers. In the second part of this closure I will deal with the discussions of well-known engineers, in the field of air and hydrogen cooling of large turbo generators, Mr. C. J. Fechheimer and Mr. D. S. Snell.

Electrical Machines in General

A question often put is; can vaporization cooled machines be used for applications for which air cooled machines are not or poorly suited? A further question is; can vaporization cooled machines stand heavy momentary or long continued overloads? One more question is; what is the minimum economical size of application?

Vaporization cooled machines distinguish themselves from air and hydrogen cooled machines of all types by:

1. Their small size.—They are practically one solid block of material. Also if a lot of power must be packed in a small space they have the advantage.

2. Their lack of air supply and exhaust ducts.—This makes them the logical choice for ships for instance. Submerged, the only connection needed is the electrical cable. Even with a poorly sealed shaft all water and air is exhausted up to the full capacity of the pumps.

3. Their inherently explosion proof design.—The thick laminated stator core, the small diameter end rings and end shields, make the machine without any strengthening proof against outside explosions. In the internal vacuum atmosphere even the worst possible explosion will not raise it to atmospheric pressure.

4. Their inherently temperature resistant construction.—The absence of air ducts and the small size of the machine facilitates insulating the end rings and end shields and if so desired the stator core. Such machines can also be used in any outside temperature.

5. Their lack of circulating fans.—The condenser pull makes them superfluous. This is especially valuable for variable speed drives. The vacuum atmosphere, makes it possible for the machines to be directly coupled to gas turbines or high pressure steam turbines with speeds of 3600 rpm and more.

In air and hydrogen cooled machines the effectiveness of the cooling is largely dependent upon the heat transfer to and from the gases. In vaporization cooled machines it is largely determined by the heat conductivity in the solids.

Moreover with enclosed machines we have two gas heat transfers. This is the reason why, contrary to vaporization cooled machines, water-cooling of the outer surface is not so effective. Heat transfer by air is about the equivalent of 12 in. heat conductance in the laminations. 3 in. of mean heat flow in the laminations is already exceptionally large. It calls for cooling the bottom of winding slots, halving the distance.

Important for overloads is that the copper losses rise with the square of the current. The iron losses remain about constant. Fluid cooling of the bottom of the coils therefore relieves the vaporization cooling. It increases the overload, large high speed machines can carry.

At low and medium load the fluid cooling will not be used, at least so far as the temperature of the conductor insulation at the bottom of the coils stays above vaporization temperature. With increasing load this precaution becomes more and more superfluous, and the fluid cooling can be pushed. Fluid cooling moreover does not put any burden upon the condenser, the vaporization fluid or the cooling water supply. All this proves that the overload capacity of vaporization cooled machines is in a class by itself.

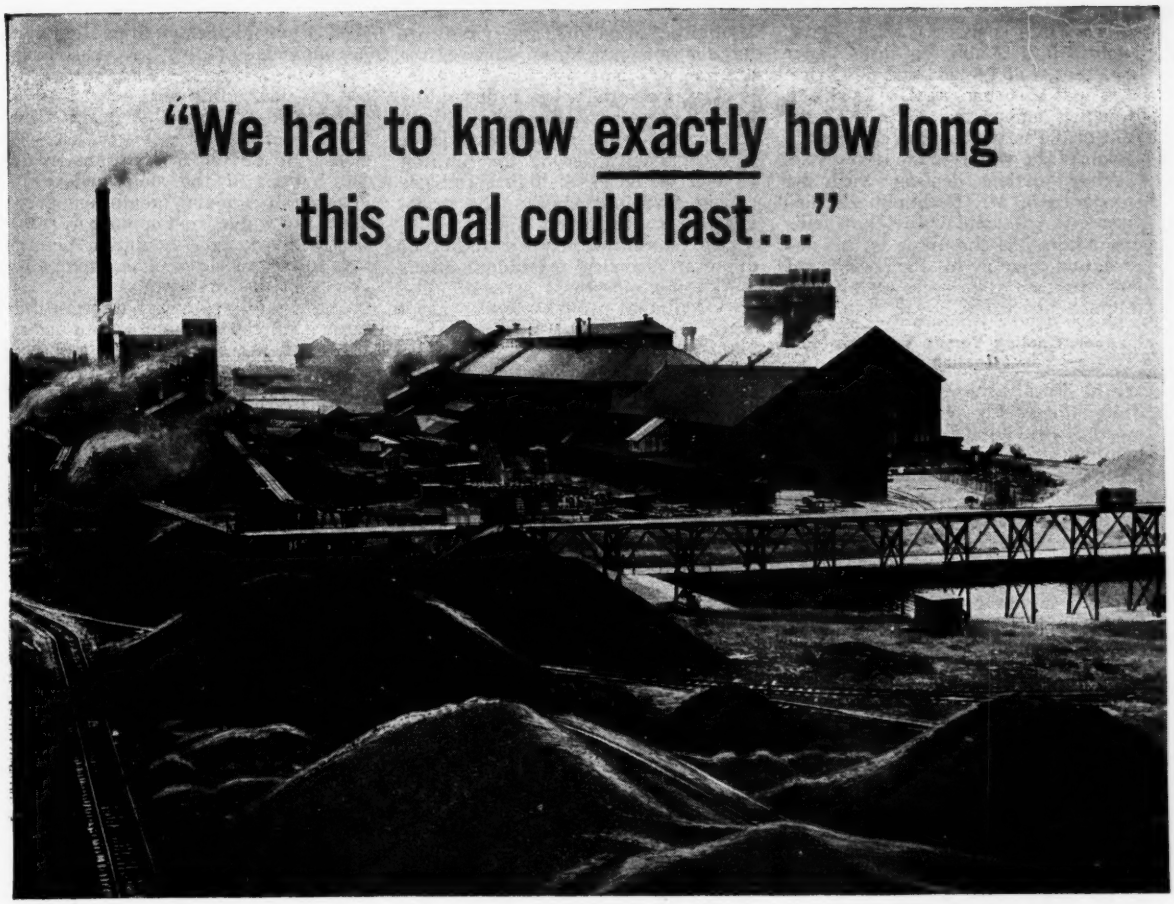
The probable lower limit in size of the useful application of vaporization cooled machines is hard to estimate. Naturally it will depend very much upon the machine qualifications required. If an open or a splashproof motor will do, the size will be much larger than when an enclosed motor is needed.

Totally enclosed machines are available up to about 400 hp, 1800 rpm. Above this size the application of vaporization cooled machines will bear investigation, if and when this type of machine becomes commercially available.

If explosion proof machines are needed the minimum economical machine size will be smaller. Where the condensing equipment can be used for several machines; for instance: paper machines, steel mill drives, locomotive drives; the minimum size will be even less. There is no upper limit to the size of vaporization cooled machines.

Large turbine generators are relatively few in number as electrical machines go. They are spectacular and therefore much in the news. Large turbine generators are crowded, it is therefore important to conserve space.

Mr. Fechheimer calculates that to absorb 1000 kwh 4 million cu ft of air at 14.7 psia, based upon the reduced density corresponding to a 30



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THE INDUSTRIAL HEAT PROVER is an exhaust gas analyzer, designed for use on industrial furnaces regardless of size or type. It is provided with two scales; one shows the percent of oxygen present above the theoretical amount necessary for complete combustion, the other the amount of unburned fuel going into the atmosphere.

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If you feel your operation could profit from scientific control of combustion why not get in touch with a Cities Service representative today. Ask for a free demonstration of the Cities Service Industrial Heat Prover.

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CITIES SERVICE

C rise, are needed. With water vaporization 812,000 cu ft of vapor are created at 1.6 psia and 30 C rise. The heat absorbed by a 30 C rise in in vapor temperature is only 2.7 per cent of the heat absorbed by vaporization of the water, without any rise.

After further dealing with the substance of Mr. Fechheimer's discussion I will deal with Mr. Snell's discussion. As the rotor is the determining factor in the design of large turbine generators we all give it much attention.

Vapor Cooling Versus Vaporization Cooling

Mr. Fechheimer's discussion is quite interesting. Why it deals mostly with vapor cooling with its heat transfer coefficient of only a fraction of the coefficient of air puzzles me. As we have seen, practically no heat can be absorbed by it with a temperature increase comparable with the increase permissible with air cooling.

The phenomena of vaporization of finely divided pressure sprays of liquid and of drop condensation are closely related. A study of McAdams therefore will explain why such phenomenal heat transfer rates, even superior to those of liquids, can be expected.

Mr. Fechheimer calculates with water vapor cooling and at 1.6 psia a rotor surface temperature rise of 182 C, at 0.8 psia of 308 C. With 115 in. axial length of the rotor body and with 25 in. axial vaporization cooled rotor surface $182 \times (115-25)/115 = 142$ C max rise. He neglects, however, the heat conductivity in the solid rotor body in axial direction. Equally spaced the axial centre distance of the hair tubes becomes $115/25 = 4\frac{1}{2}$ in. The mean axial heat flow distance is therefore $\frac{1}{2} \times (2\frac{1}{4}-\frac{1}{4}) = 1$ in. Also even 14.2 C max. surface temperature rise is far too much, independent of the vacuum pressure.

However this is not all. With long turbine generators the cooling air is forced through $\frac{3}{8}$ in. wide ducts in the stator laminations, the ducts may be as close together as $1\frac{1}{2}$ in. Also with one hair tube, with its negligible cross section, for every air duct there will be no measurable temperature rise of the rotor surface.

Referring to Mr. Fechheimer's recapitulation at the end of the discussion, the temperature drop at the cylindrical surface is obviously negligible. The vaporization temperature will be practically the same, if not lower, than the cold air temperature of closed circuit cooled machines. Even with the mean temperature rise of the coolant, added for no reason (during vaporization there is no temperature rise), we get also a temperature rise of $0+24+15+24=63$ C against $28.8+24+15+24=92$ C for air cooling.

In answering Mr. Snell's comments on heat transfer rates, it should be understood that where we have a revolving rotor, some of the air, gas, or vapor, in which it rotates is carried around with it, depending upon the pressure, the viscosity and the rotor speed. This boundary layer is recognized as being the limiting cooling factor in all high speed gas cooled machines. It has the properties of an insulating layer.

The maximum compressibility of air in an electrical machine is about 1/70th of atmospheric pressure. The air circulation pressure for an electrical machine is seldom more than 1/10 of an atmospheric.

Values for the density and the viscosity of air, hydrogen and steam at 40 C follow: The density in gram cm^{-3} for air is 0.00114, for hydrogen 0.000080 and for steam 0.000047. The viscosity in cm^{-1} gram sec^{-1} for air is 0.000189, for hydrogen 0.000093 and for steam 0.000111. This explains why the windage losses in hydrogen are about one tenth of those in air, in steam about half of those in hydrogen, with the same rotor and rotor speed.

In air cooled or hydrogen cooled machines the rotor boundary layer cannot be penetrated by the cooling gas. The maximum pressure differential available is insufficient. With water spray cooling, even if the supply pressure is only atmospheric, it is at least 10 times the pressure in the machine. The water droplets exert pin point pressure. The boundary layer can dodge them, a thing impossible with the equal pressure exerted by gas cooling. Finally, instead of having the same specific gravity, the water droplets have a specific gravity thousands of times that of the water vapor.

All this proves that the heat transfer rate will not be influenced by the rotor speed. In fact the mechanism of the spray type of vaporization cooling closely resembles that of the most favorable type of condensation, the so-called drop condensation, but in reverse. The same heat transfer coefficients can be confidently expected.

In large high speed machines with very long non salient pole rotors, the end windings cannot draw out enough heat. The sheathed radial layer design of the field coils, as well as that of the rotor teeth, do not favor the removal of the losses at the rotor periphery. Additional cooling means at the bottom of the coils must be provided.

In air and hydrogen cooled machines there is little space on the rotor even for the windings, owing to the limited radial dimensions. It is often impossible to supply adequate circulation through the interior of the rotor. In vaporization cooled machines there is no such limitation and all the cooling desired at the place desired can be provided.

Circular troughs at the shaft ends catch the water jets which supply the vaporization water needed. At the bottom of the winding slots are insulated bars (Fig. 3). In these bars are water channels sloping outward, toward the middle of the rotor. The centrifugal force distributes the water over the rotor length. Provision is made for free expansion at the bottom of the slots, where it vaporizes. A metal membrane prevents the water from coming in contact with the coil insulation before it is fully vaporized. The vapor exhausts in the air gap.

The winding slots radiate from the centre, they are close together here, so it will not be necessary to have water channels under all of them. Moreover the water needed for the cooling can be distributed at will over the channels. This is important. Load and field intensity changes can have undesirable effects upon the rotor balance. With this method of cooling slight counter acting adjustments can be made, and that for the first time, during operation.

Closing, I like an answer to the following: The contemplation of the cross section through a turbine generator rotor will hardly fill a stress analyst with admiration. The design of a field coil and its cooling is not likely to enrapture a heat transmission expert. True, many improvements have been made in turbine generators but no real strides forward, why is this? Hydrogen cooling hardly counts, its adoption was in the first place due to brilliant human engineering.

Reference: Chester W. Rice. Transactions AIEE 1923, page 699 Table VII, for densities and viscosities.

HOW TO ELIMINATE STATIC FROM SHAFTING

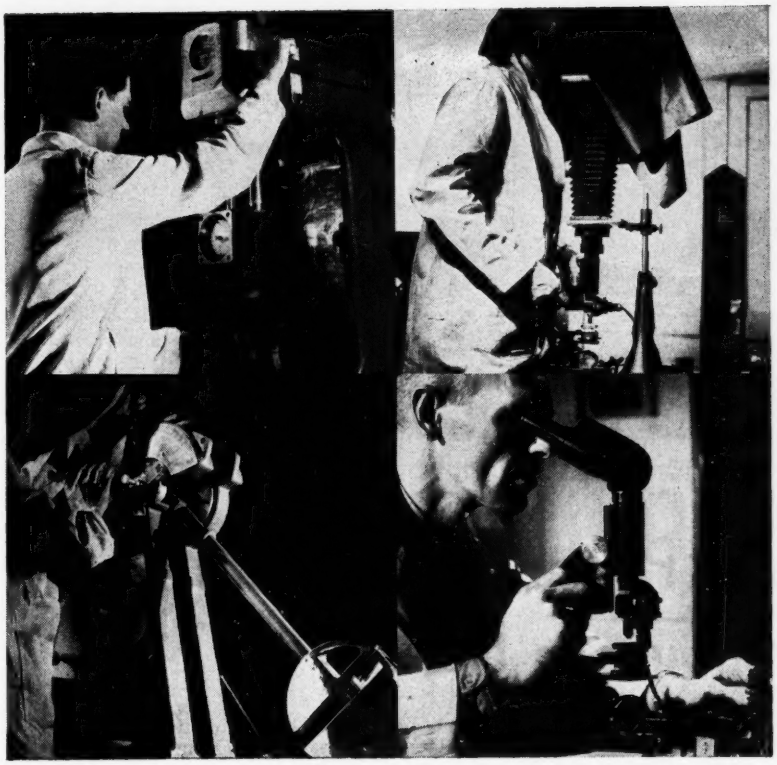
By W. E. WARNER

STATIC electricity is often present in shafting, especially if this has belt drives connected to it.

Belts often generate static, more especially in dry atmospheres. Part of this is conducted to the pulley, the amount depending on the conductivity of the belt. As the shafting is insulated from ground by the oil film in the bearings, a considerable voltage may, under some conditions, be built up.

The fact that this current does pass to the bearings is shown by the fact that the bearing oil is sometimes found to be discolored and the bearing and shaft surfaces sometimes pitted. This is often the cause of bearing troubles; and, if gear or chain drives are connected to the same shafting, it may cause trouble with them also. This can be prevented by grounding the shaft.

The best way to do this is to mount a copper gauze brush on the shaft in a way similar to the brushes on electric generators. This brush should be connected to ground. The ground and the connecting cables should be of ample size, so as to give a low resistance. This will keep the shafting at ground potential.



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What's a piece of steel made of?

THE quality of a finished product is largely dependent on the quality of the raw material from which it is made. That's why Tube Turns' laboratory technicians thoroughly test every lot of seamless steel tubing received in the Tube Turns, Inc. plant.

Answers to that important question —*What's a piece of steel made of?*— are determined in two ways. First, by chemical tests that disclose the exact percentage of the various elements present in the steel. And, second, by physical tests to determine the steel's tensile strength, yield strength, and elongation. Unless the steel measures up in all respects, the entire lot is rejected.

At the end of these tests, not only is the chemical composition of the steel known, but an accurate appraisal of its metallurgical and physical characteristics has been made. And these facts are filed by the laboratory control number rolled into each fitting to identify it permanently with the lot of steel from which it was made.

This rigid control over raw material is your assurance of basic quality in the Tube-Turn welding fittings you buy. Modern equipment in the hands of skilled technicians permit only the best steel to be used for the manufacture of Tube-Turn products.

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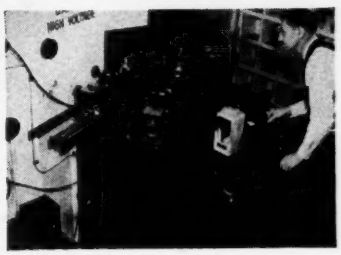
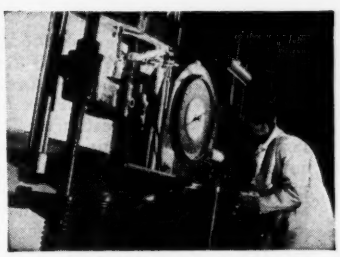
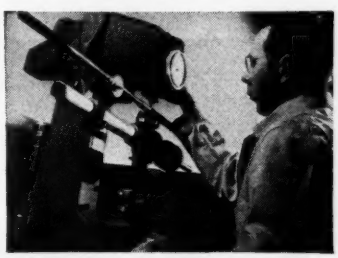
WELDING FITTINGS AND FLANGES



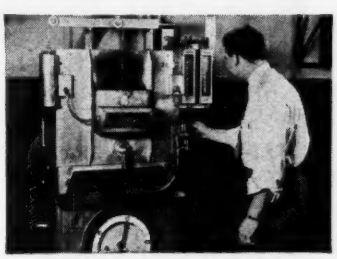
Foolproof chemical analysis of steel is made quickly and accurately on this Spectroscope, typical of the modern equipment used by Tube Turns, Inc. in the control of raw material.



Tensile strength of all seamless steel tubing is accurately measured on this machine, capable of exerting a force of 60,000 pounds. Yield strength and ductility are also checked here.



Periodic checks on the hardness of the steel are made with this Rockwell instrument to determine the strength, ductility, and machinability of the material. Brinell equipment is also used to check hardness.



Advance indication of what will happen to the steel during processing is determined with this electric furnace, one of a battery. Heat treatment to which the material will be subjected is duplicated here.

Fig. 1. View of partially finished buildings of new Alford Warehouse in Dallas, Texas; 1650 ft long; covered almost 17 acres; one building for dry storage others for cold storage and freezing

Refrigeration and Power for Alford's New 17-Acre Warehouse in Dallas

FLEXIBILITY of operation was the basic thought behind the entire design of the new Alford Refrigerated Warehouse just completed and going into operation at Dallas, Texas. These are one story warehouses, Fig. 1, covering almost 17 acres in the industrial section of Dallas. They are of steel frame construction, with concrete roofs, deck covered with aluminum sheet. The buildings are insulated with shredded redwood bark.

Refrigeration for the cooler, freezer and storage rooms is by ammonia, using calcium chloride brine for cooler and ammonia direct expansion for freezers. The refrigerant is supplied to forced-air units in the various rooms—unit coolers in which a blower directs air across coils through which the refrigerant flows. The unit coolers are located in groups, Fig. 3, in such a way as to provide positive circulation of air throughout the entire room.

To supply all the refrigeration and electric power for these gigantic warehouses, careful analysis showed that best economy would be attained by driving the ammonia compressors with natural gas-burning engines and also to use similar engines to drive generators supplying all power required by the plant. The resulting equipment is shown in the illustrations.

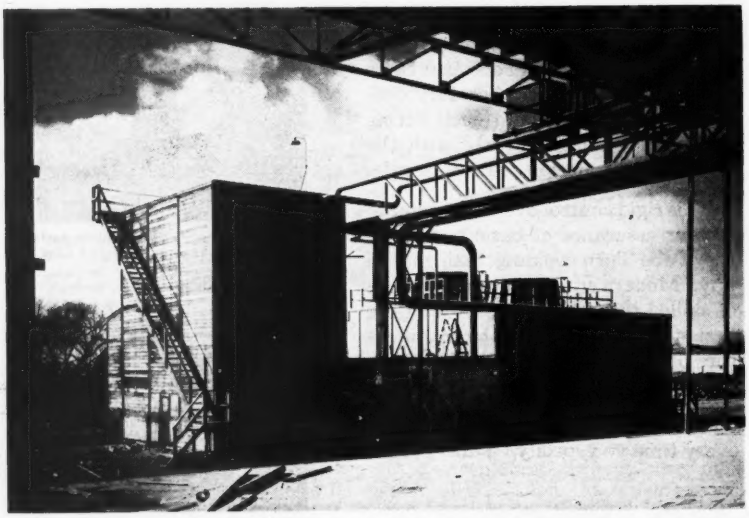


Fig. 2. Main cooling towers and pump house. At right, Marley cross-flow, induced-draft 4500-gpm condenser cooling tower. At left Lilie-Hoffman 1000-gpm, forced-draft tower for engine cooling water. Pumphouse has four Ingersoll-Rand 1125-gpm and one Allis Chalmers 1000-gpm pumps and four Weinman 250-gpm, 400-gpm and 600-gpm compressor jacket and engine cooling tower pumps

Of the four ammonia compressors two each consist of eight engine cylinders in a V, driving four ammonia compressor cylinders, three 9 by 12 in. and a fourth booster cylinder 15 by 12 in. The three main cylinders operate at 25 psig suction and 185 psig discharge. The booster operates at 0 psig, 25 psig discharge.

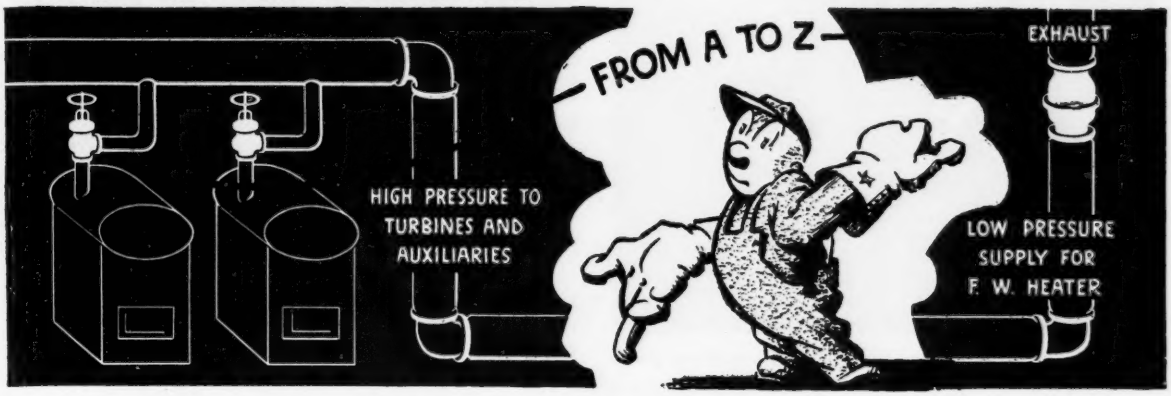
The third compressor has three 9 by 12-in. ammonia cylinders, one for 25 psig suction, 185 psig discharge, one for 50 psig suction, the third for 50 psig. Capacity pockets permit cylinders to be switched to different suction pressures.

The fourth unit also has three ammonia cylinders, one 15 by 12 in., 0-psig suction, 185-psig discharge; one 9½ by 12-in. cylinder for 25-psig suction with a capacity pocket for 50-psig suction. The other cylinder is 9 by 12 in., 20 psig discharge, with capacity pockets for 25 psig suction.

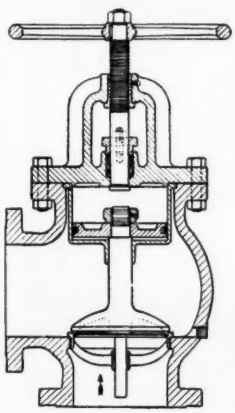
All ammonia headers in the engine room are carried on racks at one side. All suction headers are insulated with Fiberglas.

Ammonia condensers and receivers (Fig. 4) oil separators, brine and water coolers are provided, all with suitable automatic controls. An Armstrong automatic purger is installed. Cooling water for condensers and engine jackets is cooled and pumped as shown in Fig. 2. An indirect system using intercoolers is provided for engine-cylinder jacket

SAVE MONEY IN YOUR PLANT



—with FOSTER AUTOMATIC VALVES



FOSTER AUTOMATIC NON-RETURN Stop and Check Valve, Type 2

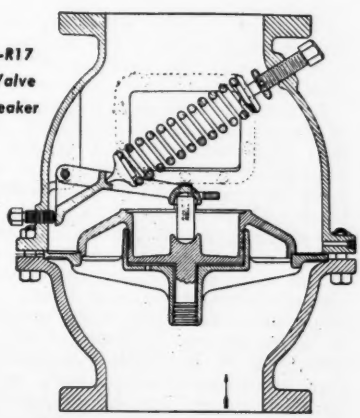
A...On your boiler drums, Foster Automatic Non-Return, Stop and Check Valves save money by doing their job perfectly—with the absolute minimum of attention—for years. It is not unusual to find these valves still giving good service after 25 or 30 years and more. Today's valves are even better.

There's nothing skimpy about a Foster Type 2. Full pipe area means negligible pressure drop across the valve. Heavy duty, through bolted construction makes it safe to work under when the boiler is down. Low pressure types to 250 lbs. (stocked) have semi-steel bodies, bronze trimmed, with stainless steel seat rings; high pressure types to 1,500 lbs. have cast steel bodies, trimmed with special heat resisting, corrosion resisting alloys. Piston chambers are renewable. They're built for lifetime service. Globe, angle, or elbow, from 2½" to 12".

Z...The R-17 Back Pressure Valve saves money by keeping the pressure where you want it on the exhaust side—for your feed water heater or other low pressure equipment—with a minimum of maintenance. Large pipe area, and large valve area mean low pressure drop across the valve, and sensitive action at low pressures. Saves make-up steam. Adjustable in ounces.

The R-17 has no outside stuffing boxes or external weights. Loading spring is on the atmosphere side of the valve and is accessible for inspection through a large handhole. Renewable seat ring and dash pot. 2½" to 20", (with sizes from 4" to 12" stocked).

Foster Type 34-R17 Back Pressure Valve and Vacuum Breaker



•••All along the line—Foster Pressure Regulators, Temperature Regulators, Pump Governors, Float Valves, Safety Valves, Check Valves, Relief Valves and Safety Valves are designed and built to save money, by giving reliable, trouble free regulation with a minimum of maintenance. When you select the proper Foster Valve and install it correctly, you are making a sound investment, backed by more than 70 years of practical experience in building good valves, and our reputation for service.

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PRESSURE REGULATORS . . . RELIEF AND BACK PRESSURE VALVES . . . AUTOMATIC STOP AND CHECK VALVES . . . ALTITUDE VALVES . . . FAN ENGINE REGULATORS . . . PUMP GOVERNORS . . . TEMPERATURE REGULATORS . . . FLOAT AND LEVER BALANCED VALVES . . . NON-RETURN VALVES . . . VACUUM REGULATORS OR BREAKERS . . . STRAINERS . . . SAFETY VALVES . . . SIRENS

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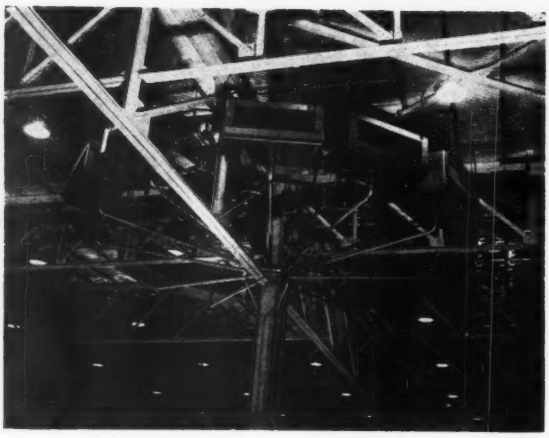


Fig. 3. Freezer, cooler and dry storage space is cooled with groups of Recold ceiling type blower unit coolers

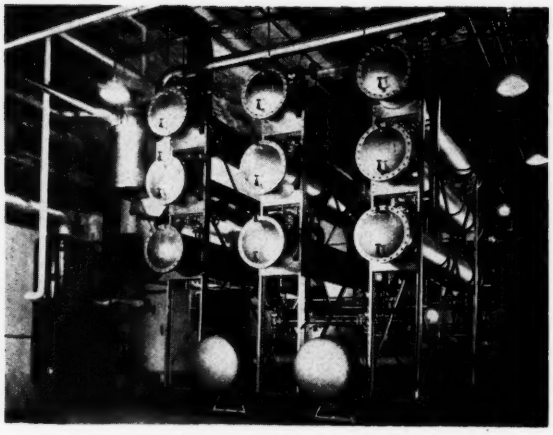


Fig. 4. Nine Frick horizontal, multipass ammonia condensers each contain 1000 sq ft; two receivers below

water. A Vilter pack-ice plant, for car-refrigerating ice, is to be installed.

Longest suction line is 800 ft long and required care to prevent excessive pressure drop. Suction lines are sized, ammonia lines are designed for expansion and contraction, are equipped with Cook bellows-type expansion joints.

Electrical power for the entire plant is generated by three 250-kw 400-rpm a-c generators, one of which is shown in Fig. 5. In addition to the generator exciters, a spare motor-generator exciter is installed. The engines driving the generators are of the same natural gas-burning type as those driving the ammonia compressors.

A complete switchboard, with all necessary meters, voltage regulators, switches and circuit breakers, and all necessary auxiliaries, is provided. Generation is at 480-v and distribution through the building at the same voltage.

Entire material handling operation of the warehouse is mechanized. A fleet of 20 battery and 4 gasoline-engine-powered Clark fork trucks is used, also one 15,000-lb Hyster truck. These trucks were used in the construction of the warehouse.

Details of how this was done, together with full discussion of the design of the warehouse and details of equipment, are given in an article in *Refrigerating Engineer,* March, 1949 by E. R. Hallowell, vice president in charge of engineering, Alford Refrigerated Warehouse. Above data were extracted from that article. Photographs were supplied through courtesy of Fred F. Alford, president of the company.

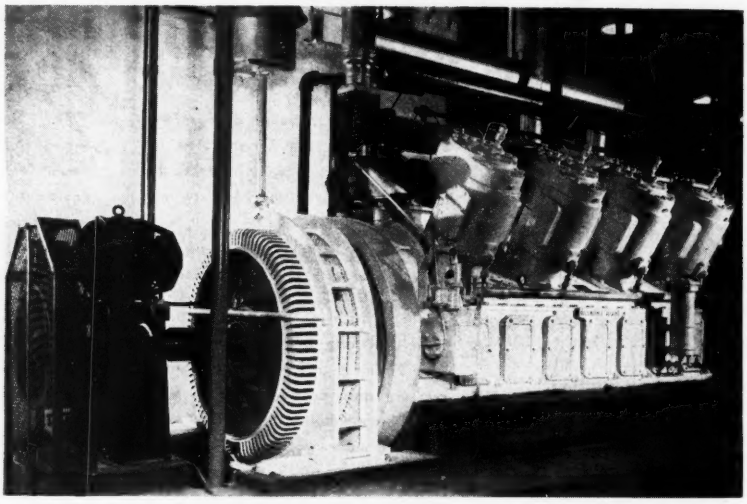


Fig. 5. One of three Ingersoll-Rand 375-hp natural gas engines, each driving an Electric Machinery Mfg. Co. 250-kw, 0.8-pf, 480-v, 400-rpm synchronous generator to supply all electric power for the plant

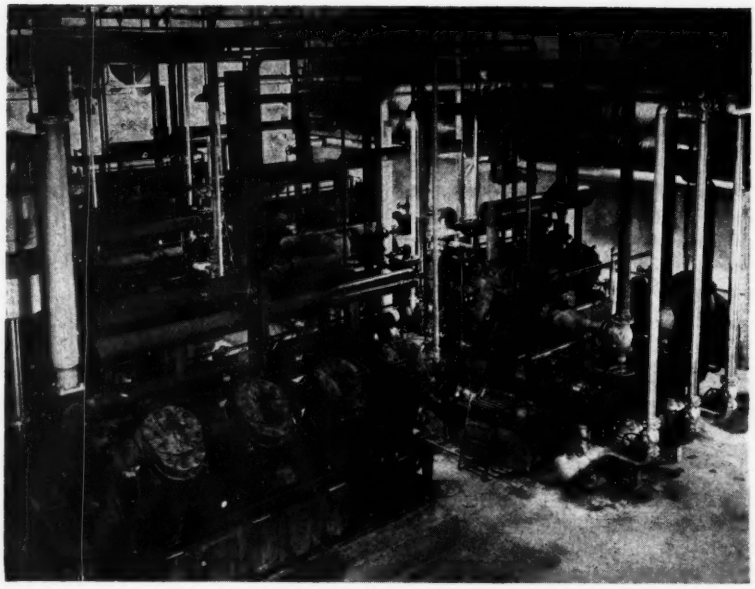


Fig. 6. General view in engine room. At right, one of four main Ingersoll-Rand ammonia compressors, driven by heavy duty V-type natural gas engine. At left, one of the electric generating units (see Fig. 5). There are also two York and one Frick standby compressors driven by Continental natural gas engines

HAVE YOUR BOILERS EQUIPPED WITH

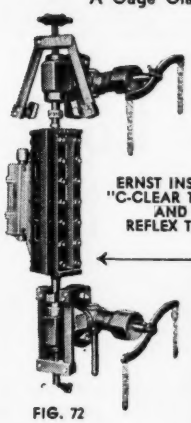
Split-Gland Type Water Gages

Bronze and Drop Forged Steel Construction
For Pressures up to 900 Pounds

FIG 1
High and Low Alarm Column Split-Gland Gage Inclined.

NO GAGE GLASS PACKING NUTS

No Tools Required to Change A Gage Glass



WATER LEVEL VISIBLE FROM BELOW

ERNST INSERTS "C-CLEAR THRU" AND REFLEX TYPE

FIG. 72

GUARDS WIRE GLASS AND PLASTIC

FIG. 9

HIGH PRESSURE GAGE GLASSES
ROUND-TUBULAR clear & red-line magnifying
also FLAT GLASSES clear & reflex type — all sizes —

ALSO
HIGH PRESSURE
HIGH TEMPERATURE
SERIES 750
Gage Glass Gaskets
Made in all sizes to fit your present water gage fittings.

OTHER *Ernst* PRODUCTS

- WATER COLUMNS (High & Low Pressures)
- WATER GAGES (All Types) BRONZE, STEEL, ALL IRON
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- MICA SHIELDS
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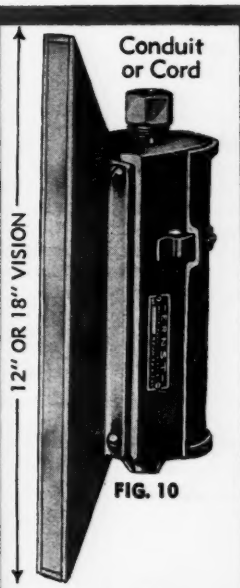


FIG. 10

Non-Glare "PLAIN SIGHT" ILLUMINATORS
give a clear, distinct reading of water level.

ERNST WATER COLUMN & GAGE COMPANY
[illegible] LIVINGSTON AVE., LIVINGSTON, N. J. — TELEPHONE: LIVINGSTON 6-1400

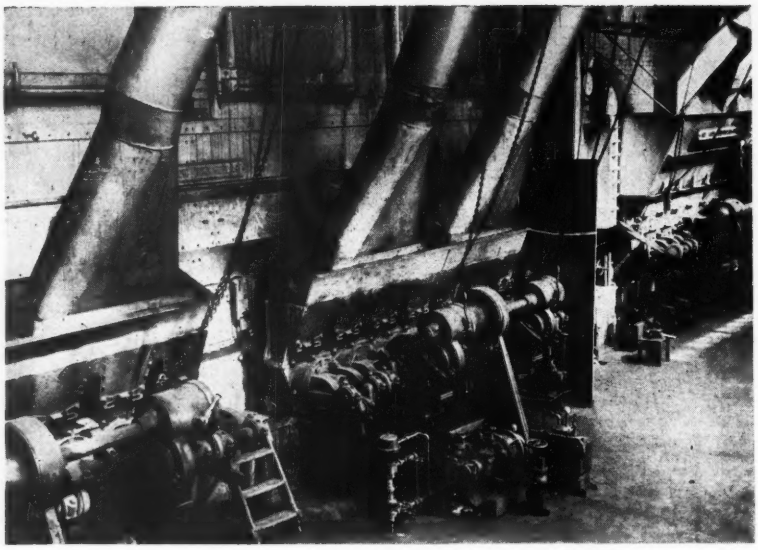


Fig. 1. View in boiler room of typical medium-sized industrial power plant. In this plant, there was an instance of poor planning; drive for stoker in center was located at right, so it had to be moved and remodeled before new boiler at right could be installed

Take a New Look at Your Industrial Power Plant

By C. D. GIBBS
Consulting Engineer

MOST INDUSTRIES require one or more of the following services: Steam, electricity, compressed air, or water. To provide these, a power plant is usually built as an adjunct to each particular industry. Steam is nearly always required, if only for heating. Electricity may be purchased or generated. Compressed air can be obtained from compressors operated by steam or electricity. Water can be obtained from streams and wells, or it can be purchased; but, where hot water is required the heating is usually supplied by the power plant.

The industrial power plant, therefore, may vary from the simple unattended boiler plant supplying steam for heating, to a complete steam-electric station rivaling many public utility stations. The larger industries usually have an engineering staff of sufficient size and ability to design these larger stations to meet the requirements of the particular industry in the most economical and

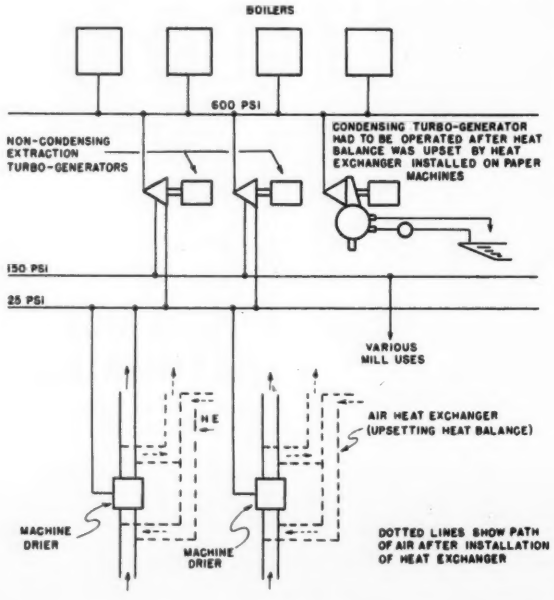
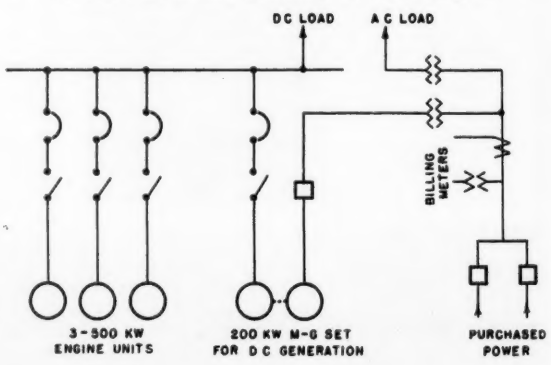

BOILERS
600 PSI
NON-CONDENSING EXTRACTION TURBO-GENERATORS
CONDENSING TURBO-GENERATOR HAD TO BE OPERATED AFTER HEAT BALANCE WAS UPSET BY HEAT EXCHANGER INSTALLED ON PAPER MACHINES
150 PSI
25 PSI
VARIOUS MILL USES
H E
AIR HEAT EXCHANGER (UPSETTING HEAT BALANCE)
MACHINE DRIER
MACHINE DRIER
DOTTED LINES SHOW PATH OF AIR AFTER INSTALLATION OF HEAT EXCHANGER

Fig. 2. (Left) Illustrates how loss of power plant efficiency resulted from production department's recommendation. New heat exchangers on machine driers upset power plant heat balance so that standby condensing turbine generator had to be operated, thus increasing plant fuel cost and offsetting saving from heat exchangers

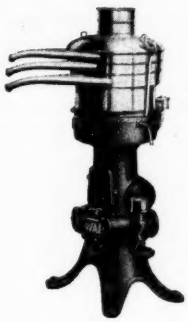
Fig. 3. (Below) One-line diagram of original connections of motor-generator set in hotel generating d-c and buying a-c



SINCE 1878 ... DE LAVAL MACHINES HAVE BEEN FIRST

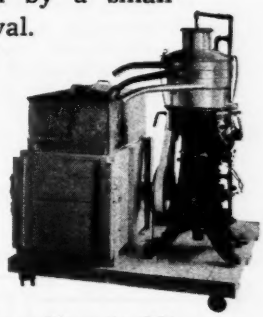
1878 - Carl Gustav De Laval invents the first continuous centrifugal Cream Separator. Tries tubular bowl design.

1879 - Dr. De Laval abandons tubular type bowl for the more efficient wide disc bowl revolving at lower rpm.

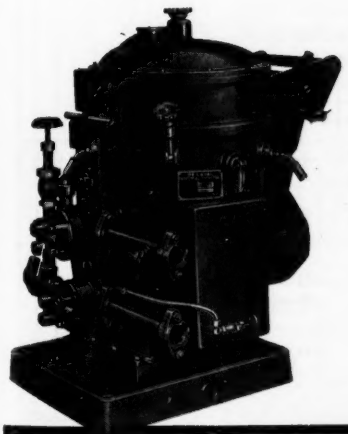


1918 - First centrifugal Oil Purifier introduced by De Laval. This continuous Oil Purifier was driven by a small steam turbine, also invented by Dr. De Laval.

1922 - First De Laval centrifugal Insulating Oil Purifier installed. In 1949, the De Laval method is still the safest way to maintain insulating oil because water, once discharged, cannot recontaminate the dehydrated oil.



1934 - De Laval introduces its "Uni-Matic," centrifugal Oil Purifier complete with integral pumps and heater.



1949 - New, larger Model 67 "Uni-Matic" with purifying capacity of approximately 450 gph on turbine oil. De Laval, backed by 71 years of experience with centrifugal purification, continues to provide power plants with the means of utilizing centrifugal force most effectively and economically.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL OIL PURIFIERS

for more dependable power production

adequate manner. However, there are many smaller and medium sized industrial companies whose power plants are far from economical, or even adequate for the needs of the industry. It is the purpose of this article to point out to "management" the attitude that should prevail regarding their power plant and the method by which they can obtain satisfactory and economical services.

Too often management considers the power plant a necessary evil to their manufacturing processes, and while the latter receives constant analyses and supervision to obtain improvement, the former is ignored. This may be lack of interest, or it may result from the assurance of subordinates that the power plant is satisfactory. The power plant probably was built many years before and has shown a long record of continuous service, thereby creating a feeling of "let-well-enough-alone".

Management should consider certain features. First, when this present power plant was built, fuel, labor and maintenance cost little compared with present day costs. Second, the art of steam generation has improved, resulting in higher efficiencies — efficiencies undreamed of when the plant was first built. Third, higher standards of service have been obtained. Interruptions of services, once accepted, are now inexcusable.

How Process Change Can Affect Power Costs

Management, when conscious of the cost of services, too frequently considers the individual recommendations of department heads who see methods of reducing the cost of service to their particular department, without visualizing its relation to the entire service cost. Adoption of such recommendations frequently leads to an increase in the total service cost, even though reducing the cost to one department.

An example of this is the case of a paper manufacturer who, following the paper superintendent's recommendation, installed heat exchangers by which the hot, moist air leaving the paper machines heated the incoming air, as in Fig. 2. This procedure reduced the low pressure steam required by the driers and, therefore, reduced the amount of steam charged to the paper machines. However, it upset the heat balance on the non-condensing extraction turbines so that they were unable to carry the electrical load which in turn necessitated operation of a condensing turbine-generator and increased fuel consumption.

The chief engineer of the power plant is the main source of information regarding its operation and frequently his statements and recommendations are accepted without question by the management. This chief engineer may be a thoroughly competent man who views the entire problem correctly, in which case the management should follow his recommendations. Too often, however, the chief engineer is a good operating man, but lacks knowledge of, or even interest in, the improvements in the art. Then too, he may be selfishly inclined, devoting his efforts to perpetuating his job by maintaining no records, or inadequate ones, or even going so far as to destroy blueprints of the plant layout or equipment construction.

At times, management even boasts that the chief is the only one who knows the plant and that they would be lost without him. This is very nice for the chief engineer, but it can be very unfortunate for management, as it was in the case of an educational institution: The chief engineer of this institution died and as he had destroyed the drawings of the plant, much money was spent in locating buried pipe lines when a stoppage occurred.

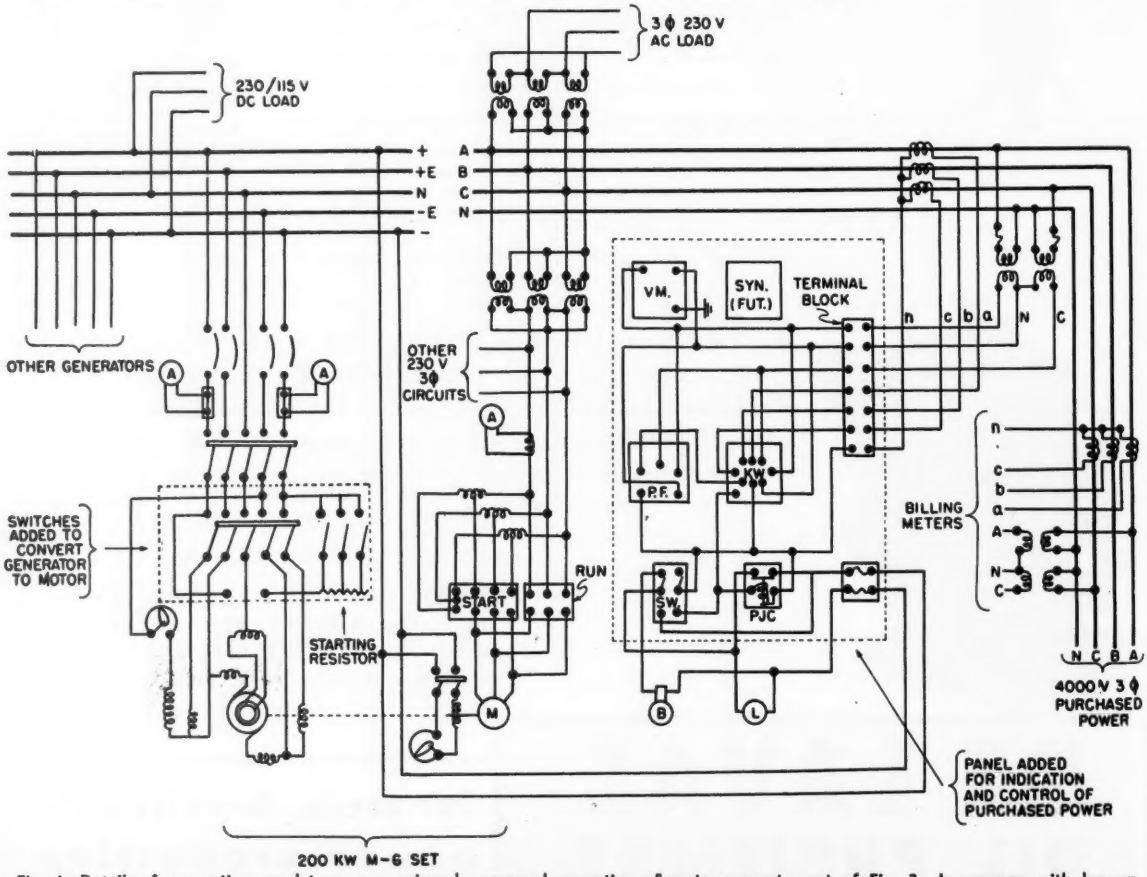
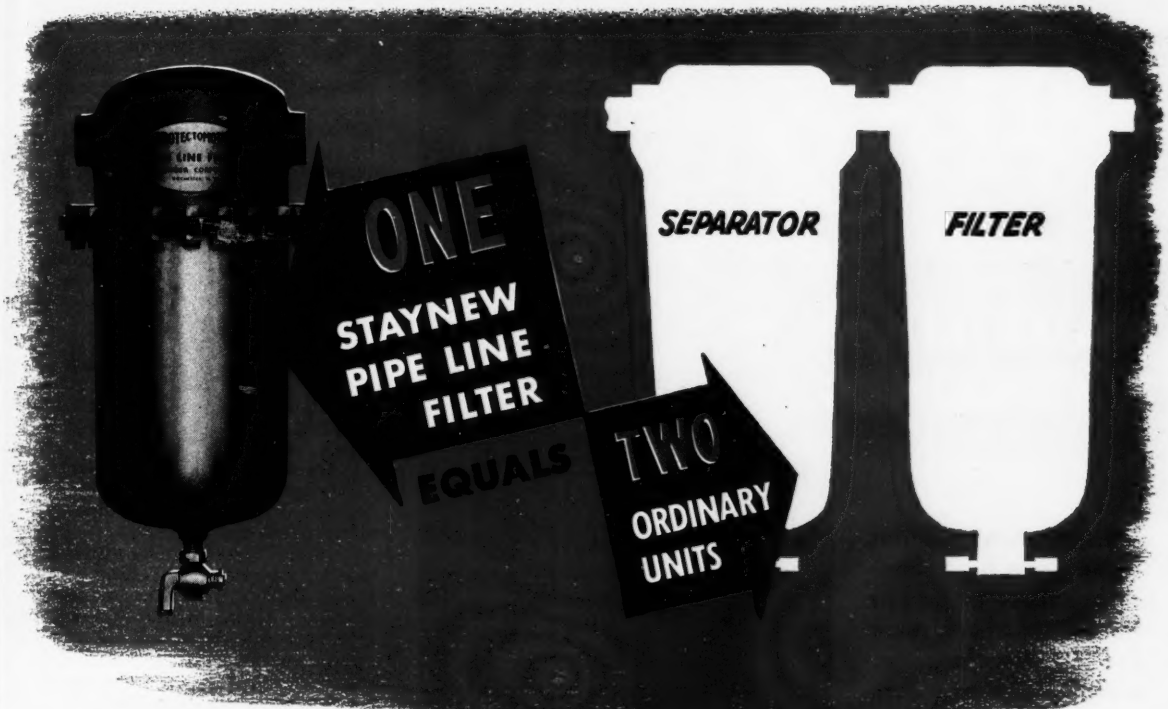
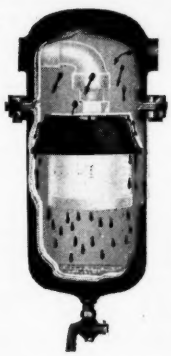


Fig. 4. Details of connections used to secure savings by reversed operation of motor-generator set of Fig. 3. In summer, with low exhaust steam demand, m-g set generates d-c, being driven from a-c line; in winter, with high exhaust demand, when heating load requires more low-pressure steam than normal engine exhaust can supply m-g set produces a-c, being driven from d-c circuits

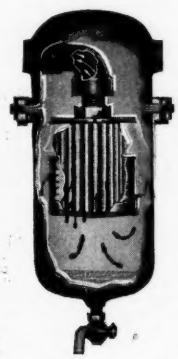


EXCLUSIVE DOUBLE ACTION PRINCIPLE GUARANTEES BOTH CLEAN AND DRY AIR



1. MECHANICAL SEPARATION

Deflector cup directs flow of air or gas together with water, oil and dirt to the walls of the housing and thence downward at high velocity into the base where liquid and heavier dirt particles are deposited.



2. FILTRATION

Air or gas, having been mechanically cleaned, rises at low velocity through the Radial Fin Filtering element or insert which removes the lighter airborne material.

The popularity of Staynew Double Action Pipe Line Filters increases as manufacturing tolerances decrease—as vanes and pistons are closer fitted, orifices are made smaller, machines in general are built to more precise limits and processes are more scientifically controlled. Inexpensive, quickly installed and easily maintained, these filters provide highest filter efficiency with low overall maintenance.

IMPORTANT APPLICATIONS

Protection of Air-operated Tools ★ Paint Spray ★ Sand Blast ★ Air Displacement of Liquids ★ Air-operated Instrument Controls Liquid Agitation

COMPLETE DATA ON REQUEST

DOLLINGER CORPORATION

DOLLINGER PROTECTOMOTOR REG U.S. PAT OFF STAYNEW FILTERS

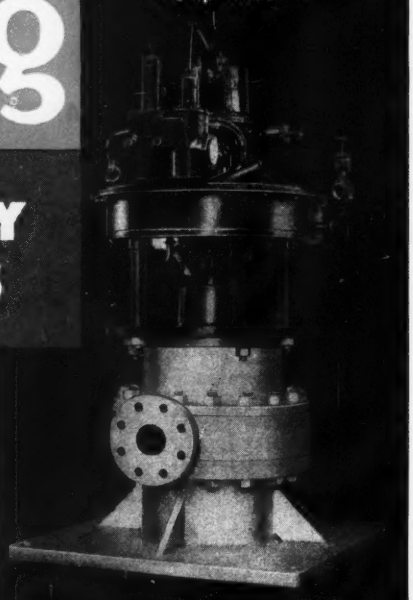
CENTRE PARK ROCHESTER 3, N. Y. REPRESENTATIVES IN PRINCIPAL CITIES

MORE THAN 1,000,000 STAYNEW PIPE LINE FILTERS SOLD TO INDUSTRY

Wing

AUXILIARY TURBINES

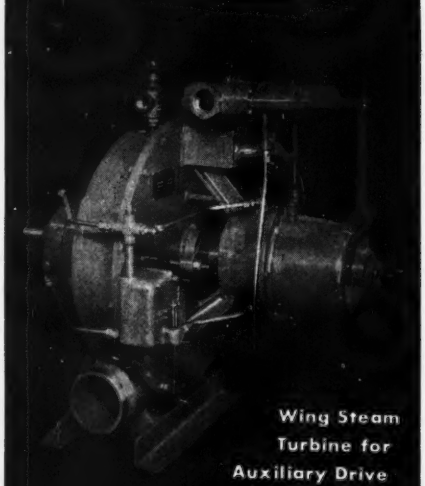
Wing All-Steel Welded Vertical Turbine for Pump Drive



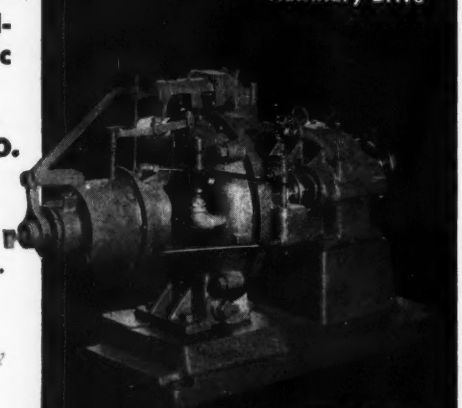
Wing Steam Turbines have been a dependable source of power in industrial and marine applications for over a third of a century. During that time these sturdy, dependable prime movers have been giving satisfactory service in thousands of industrial and marine installations under the most exacting conditions of service.

Wing turbines today are available for pressures up to 600 psi. and temperatures up to 750° F.

Write for turbine bulletin or for specific details.



Wing Steam Turbine for Auxiliary Drive



Wing Turbine and Gear Combination on common pedestal base

L. J. Wing Mfg. Co.
64 Seventh Ave.
New York 11, N. Y.
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Newark, N. J. • Montreal, Can.

Frequently the adoption of the chief engineer's recommendations result in a "Topsy-grown" plant, expensive to operate and requiring frequent replacement of equipment either because it is inadequate, or because it was installed where it blocked future plant development, although it did solve the immediate problem. In one industrial plant, the stoker drive unit was installed in the space provided for a future boiler. When this boiler was required, an outage was necessary to relocate the drive unit.

Whatever the chief's ability, the wise management will check, by means of an independent* source, any major capital investment before adopting his recommendations blindly.

What Does Engineering Cost?

Another weakness of management is that of expecting the manufacturer to do his engineering—gratis, of course. The manufacturer is primarily interested in selling equipment; that is where he makes his money. When, in the interest of making a sale, he is expected to do application engineering for management, he frequently obtains the necessary information from the industrial plant's chief engineer; consequently, the resulting job reflects the wishes or prejudices of the chief. The equipment so selected may be over- or undersize; it may have the wrong characteristics for future plant development; and many times it is located in such a manner as to block future plant enlargement.

An example of this is the case of a paper company where a boiler, too large for the load, was installed by a boiler manufacturer and provided with pulverizers. During light load, this plant had to fall back on the more expensive fuel oil for operation.

Perhaps the most serious objection to manufacturer's engineering is that it eliminates competition and by so doing causes the purchaser to pay more than he should. That gratis engineering is no longer gratis —just concealed.

Also, there is no check on the manufacturer's furnishing what he proposed to furnish. Chiseling on

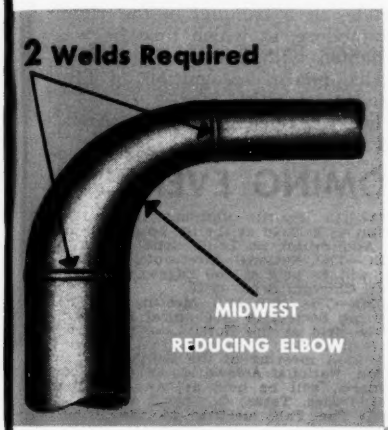
*Editor's Note:—Judging from his own work and that of all the other good consulting engineers we know, the author does not mean that the chief engineer's wishes or ideas are always and necessarily wrong. We have often seen how the plant operating staff can make many valuable suggestions about increasing ease, efficiency and safety of operation. Often, however, these operating men are not able to convince industrial management. But when the consultant finds their ideas are good, he should back up the chief and work his ideas into the scheme.

In fact, no consultant can successfully ram things down the throat of the plant operating men. The successful consultants we know often tell management that many of the best ideas they are going to suggest have probably been advocated by the plant's own staff. The consultant, however, with an outside, unbiased point of view, can help evaluate them. That is one of his most important functions.

SAVE MONEY and get BETTER PIPING by using the

MIDWEST

REDUCING ELBOW



Instead of a Standard Elbow and a Reducer

The Midwest Reducing Elbow saves more than a third of the welding when used instead of a standard elbow and reducer. In addition to a substantial saving in time and money, it provides much neater appearance and insulation is easier. The gradual reduction, smooth curve and absence of abrupt neck reduce the pressure drop and turbulence. Center-to-end dimensions are the same as for ASA standard elbows.

All the advantages of Midwest Standard Elbows are to be found in Midwest Reducing Elbows . . . unusual dimensional accuracy and uniformity, stress relieving, beneficial effect of working metal in compression, etc.

The Midwest Reducing Elbow is only one of many fittings developed by Midwest to reduce the cost and improve the quality of welded piping. You will find it advantageous to get in touch with the Midwest Distributor near you whenever you need welding fittings.

MIDWEST WELDING FITTINGS

Improve Piping Designs and Reduce Costs

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Main Offices: 1450 South Second Street, St. Louis (4), Mo.

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capacities, efficiencies, or reliability are not uncommon. For example: Several oil fired boilers of an ordnance plant, which were represented to have a maximum capacity of 45,000 lb per hr, smoked excessively for loads above 27,000 lb per hr and never could develop more than 30,000 lb per hr.

To safeguard his interests, management should employ a reputable firm of consulting engineers; First, to obtain an unbiased determination of the service requirements of his industry; second, to analyze his present power plant, to ascertain the adequacy and cost of supplying these services; third, to recommend changes to the power plant, or the substitution of other means of supplying the requirements. These findings should be incorporated in a report to the management, prior to the authorization of any construction.

Small Change Saves $1000 a Month

We all tend to get too close to our own problems and, sometimes, fail "to see the forest for the trees". At times like these, a consulting engineer can bring a fresh view to the existing problem, often saving thousands of dollars.

An example of this is the case of a hotel which used both purchased alternating current and generated direct current. They had a spare motor-generator set for supplying direct current in the event of a boiler outage. Their consultants recommended the use of this set to generate direct current in summer, when there was little need for exhaust steam, and to generate alternating current in winter, when the heating load requires more low pressure steam than the normal engine exhaust. The operation of the set in this manner saves the hotel approximately $1000 per month.

After the consultant has made his recommendations, and if they are accepted by management, his next service should be the preparation of plans and specifications for purchasing and construction. The purchasing of equipment may be done either by the management or by the consultant, but in either case the bids should be compared by the consultant to insure that satisfactory equipment is being furnished and that the bids are on an equal basis.

Finally, the consultant can serve management by field supervision, to insure that the erection is done correctly and that acceptance tests are made to determine if management is getting the results for which it paid.

Obituaries

WILLIAM H. LAWRENCE

WILLIAM H. LAWRENCE, seventy-nine, who retired in 1937 as chief operating engineer of Consolidated Edison Co. of New York, Inc., died at midnight August 8, at Lenox Hill Hospital, New York City, following a month's illness.

Mr. Lawrence was born in Middletown, Ohio, February 24, 1870. Following graduation from high school there, he came to New York and, in October 1889, was first employed as a brushman by the Edison Electric Illuminating Co.

Mr. Lawrence was active in many professional societies. He belonged to the AIEE, ASME, New York Electrical Society and NELA.

Mr. Lawrence lived at the Hotel Gramatan, Bronxville, New York. He is survived by his widow, Mrs. Mary Lawrence, whom he married in 1895, and two brothers, Howard F. and Walter F. Lawrence, and a sister, Mrs. G. O. Michael, of Middletown, Ohio.

WILLIAM LLOYD

WILLIAM LLOYD, designer and consultant on stoker engineering for Combustion Engineering-Superheater, Inc., died in New York on Aug. 7, following a brief illness. He was 82 years old, but had regularly attended his office until a few days before his death.

The Coxe Traveling Grate Co. was organized in 1914, with Mr. Lloyd as president, and when this company was purchased by Combustion Engineering in 1917, he continued with the latter company and later brought out the Lloyd stoker.

He was a member of the A.S.M.E., and is survived by two sons, Grier and Menzo, two brothers and several grandchildren.

J. D. BERG

J. D. BERG, chief executive officer and a director of Dravo Corp. Pittsburgh, passed away suddenly, June 29, in his home at Chatham, Cape Cod, Mass. at the age of 66.

Mr. Berg has headed Dravo Corp. since the death of its founders F. R. and R. M. Dravo in 1934. He served as board chairman from 1934 to 1946, at which time he was elected to his present position. Although Mr. Berg resided for the past two years in Chatham, Mass., he remained active in the affairs of the Company.

Mr. Berg became identified with Dravo-Doyle Co., now a subsidiary of Dravo Corp., in 1906 as sales engineer, becoming vice president in 1908 and president in 1923. He was prominent in civic affairs as well as being an outstanding Pittsburgh industrialist. He was a director of Dravo-Doyle Co., Fullerton-Portsmouth Bridge Co. and Consolidated Natural Gas Co.

JOHN L. DALY

JOHN L. DALY, a member of the Sales Department of Combustion Engineering — Superheater, Inc., New York, died at his home in New Brunswick, N. J., on Tuesday evening, August 16, at the age of 70.

A graduate of New Brunswick Business College, he began his business career with the Heine Boiler Company in 1899. When that organization was acquired by Combustion Engineering in 1927, he continued in sales work with the latter company.

Mr. Daly had one of the longest service records in his organization. In May of this year he was honored by nearly three hundred of his associates at a banquet in the Hotel Commodore, at which time he was presented with a diamond-studded service pin in recognition of fifty years' service.

He is survived by his wife, Anna, and a brother, Frank.

COMING EVENTS

ISA—The Fourth National Instrument Exhibit to be held at the St. Louis Municipal Auditorium, St. Louis, Sept. 12-16.

NEC—The National Electronics Conference will be held at the Edgewater Beach Hotel, Chicago, Sept. 26-29.

ASME—The 1949 Fall Meeting of The American Society of Mechanical Engineers will be held at the Hotel Lawrence, Erie, Pa., Sept. 27-30.

NACE—A meeting of the South Central Section, National Association of Corrosion Engineers, will be held at the Adolphus Hotel, Dallas, Texas, October 3 and 4.

PEA—The Fall meeting of the Prime Movers Committee, Pennsylvania Electric Association, will be held at the Hotel Edison, Sunbury, Pa., Oct. 6 and 7.

ASTM—The First National Meeting of the American Society for Testing Materials to be held on the West Coast will be held at the Fairmount Hotel, San Francisco, October 10-14.

NMC-NME—The National Metal Congress and National Metal Exposition sponsored by the American Society for Metals, American Welding Society, Metals Branch, American Institute of Mining and Metallurgical Engineers and the Society for Non-Destructive holding combined annual meeting at the Public Auditorium, Cleveland, October 17-21.

ASCE—1949 Meeting of the American Society of Civil Engineers, Summer Convention, Mexico City, July 13-15; Fall Meeting, Washington, D. C., November 2-4.

Midwest Power Show—The 9th Midwest Engineering and Power Exposition will be held at Navy Pier, Chicago, November 11-16.

HELPFUL BULLETINS

(Continued from page 36)

and other materials. Furnishes erecting and operating instructions for the crusher, complete dimensional drawings. Illustrates, by photos, several installations of these crushers. American Pulverizer Co.

MISCELLANEOUS

136 **Industrial Buildings**—Here's an 8-pp illustrated catalog describing manufacturer's design principle for economical rigid frame steel building construction. It explains how this rigid frame method affords speedy construction without a network of trusses. Special applications for industrial and other buildings, either conventional or eccentric in design, are discussed in full and illustrated with line drawings and photographs. McCloskey Co. of Pittsburgh.

137 **Motor Bearing Lubricant**—Silicone Notes No. D-6, 4 pp, contains information on the use of a silicone grease in the bearings of electric motors. It includes instructions for lubricating open and single shielded ball bearings and relubrication schedules based on the manufacturer's experience in developing and testing the product. The use of double shielded and cartridge type ball bearings prelubricated for life with the grease is also discussed. Dow Corning Corp.

DRAVO CORPORATION
POWER DEPARTMENT
Engineering Constructors

DUQUESNE LIGHT COMPANY'S Frank R. Phillips Power Station at Wireton, Pa. Units 2 and 3, now being constructed by Dravo, will more than triple the original 75,000 kw capacity of this key station serving the Pittsburgh area.

DRAVO
CORPORATION
DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering Constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations—fabricators and erectors of power piping—power and boiler plant equipment.

PITTSBURGH · PHILADELPHIA · CLEVELAND · NEW YORK · DETROIT

How to keep purchased power under control...

Ohio leather manufacturer keeps efficient balance between generated and purchased electric power with Worthington turbine-generator unit.

At the Ohio Leather Company, Girard, Ohio, purchased power is kept under direct control by means of a steam turbine generator unit which operates as a "reducing valve" to bring boiler pressure down to required levels for use in plant processes.

The turbine, a Worthington 750 KW straight non-condensing type, operates in parallel with the source of purchased power and has an automatic governor control responsive to both purchased or primary power and to plant demands for processing steam. This results in:

- limiting the *maximum* demands on purchased power to a predetermined top level, regardless of plant steam demands.
- limiting the minimum demands to a level which will prevent return flow of power to primary source when plant steam demands are high and power demands low.

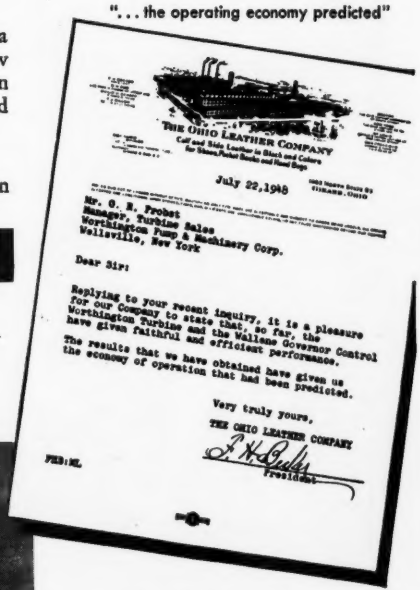
SAVE WITH WORTHINGTON

Savings to date on this installation are at a rate indicating 100% return on the initial investment in three years! For further details that prove *there's more worth in Worthington*, call your nearest Worthington District Office . . . or write direct to *Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.*

WORTHINGTON

STEAM TURBINES

"... the operating economy predicted"



THE OHIO LEATHER COMPANY
Calf and Side Leather in Black and Colors
for Shoes, Pocket Books and Hand Bags

July 22, 1948

Mr. G. B. Probst
Manager, Turbine Sales
Worthington Pump & Machinery Corp.
Wellsville, New York

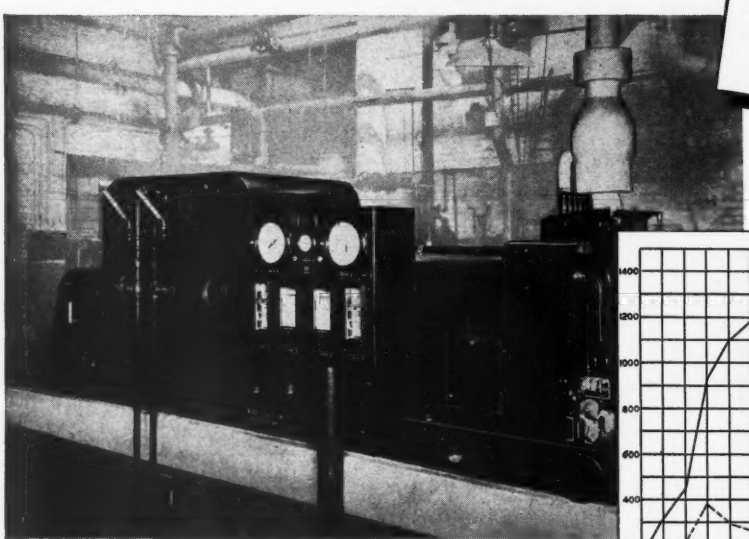
Dear Sir:

Replying to your recent inquiry, it is a pleasure for our Company to state that, so far, the Worthington Turbine and the Wallene Governor Control have given faithful and efficient performance.

The results that we have obtained have given us the economy of operation that had been predicted.

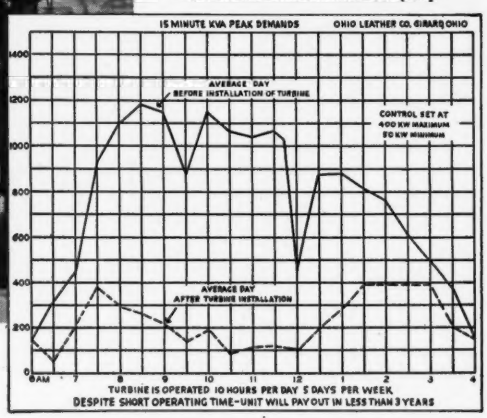
Very truly yours,
THE OHIO LEATHER COMPANY
F. W. Gallo
President

FWG:HL



The Ohio Leather Company installation is a direct-connected turbine generator unit, 750 KW, 3600 rpm, 240 volt 3 phase 60 cycle. Steam conditions are 240 psi, 450° F, exhausting at 5 psig. Controls are by Wallene Engineering Co., Cleveland, Ohio.

"BEFORE AND AFTER"
... at the Ohio Leather Company



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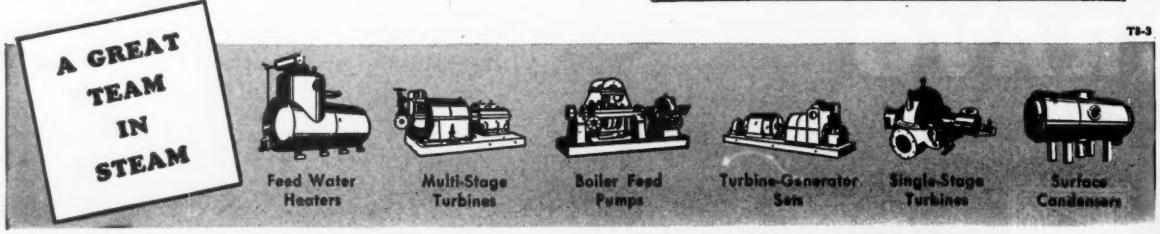
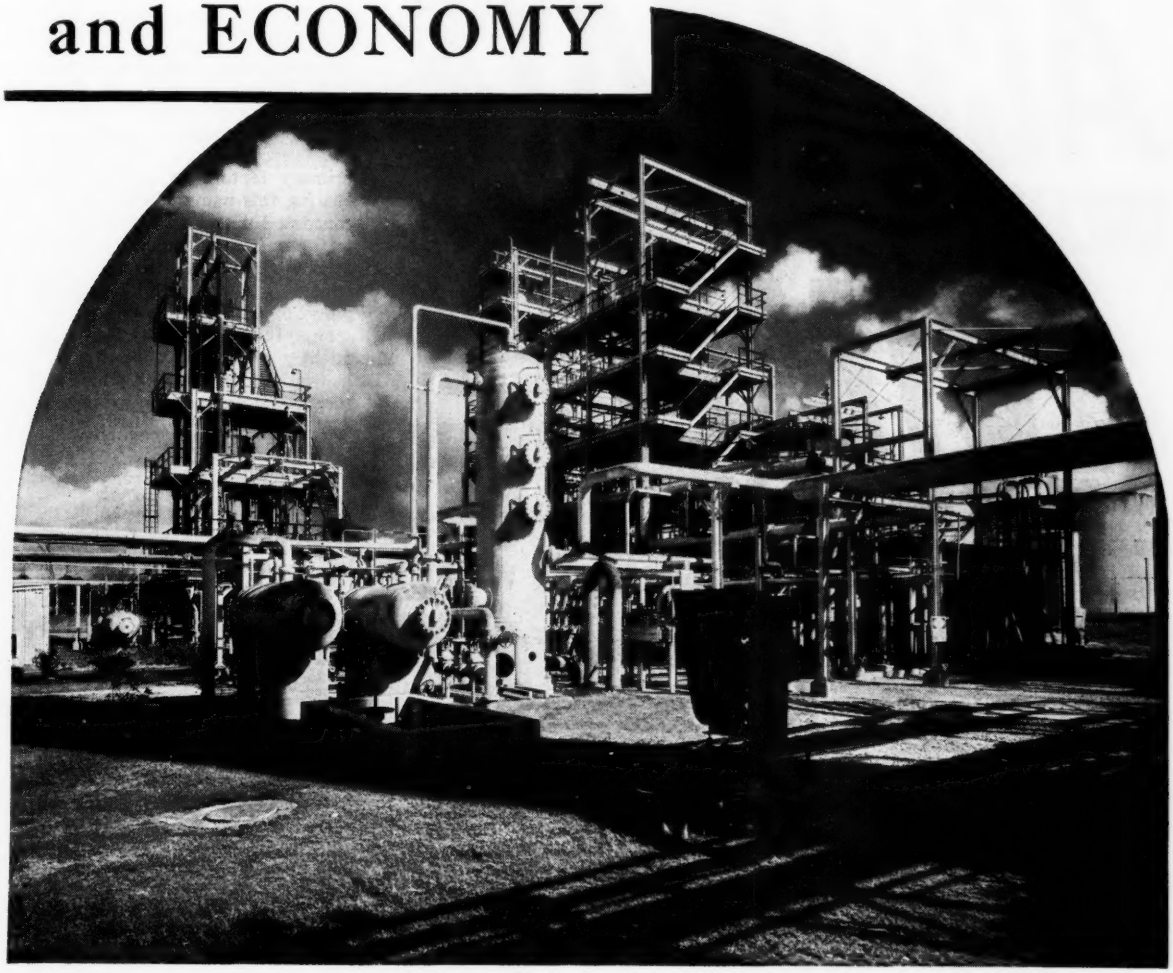


EFFICIENCY and ECONOMY



IN the planning and execution of expansion programs, Stone & Webster Engineering Corporation offers to industrial organizations the efficiency and economy resulting from a competent and coordinated engineering and construction staff with broad experience in all phases of design and construction.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY OF STONE & WEBSTER, INC.

IF IT ISN'T ACCURATE IT ISN'T SIMPLEX

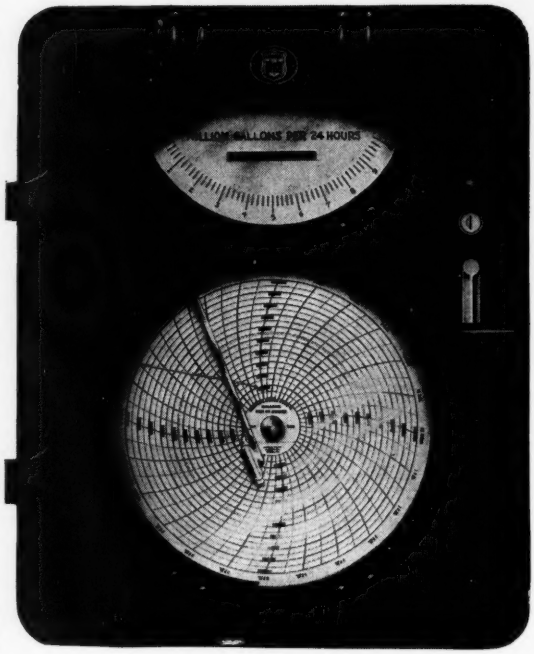
We of Simplex believe the discerning engineer requires accuracy above all other things in any instrument he purchases. If the word "Simplex" could be translated into modern language it could well mean accuracy, for that is the primary feature of all products bearing this name. While we are concerned with long life, continuous operation, and modern appearance, we nevertheless stress and stress again the most important point of all – accuracy. In presenting the type H meter, we confidently offer to the industry an instrument which fulfills this feature to an extremely gratifying degree.

NEW TYPE H METER

Most accurate yet developed within its flow range

ACCURATE within ± 2% at any point over flow ranges up to 10 to 1, the meter is designed for:

- Use with Venturi Tube, Flow Nozzle, or Orifice Plate.
- Measurement of hot or cold water, process liquors or gases.
- Outdoor or indoor mounting, using the same instrument for both conditions.
- Inclusion of three vital measuring elements—indicator, recorder, and totalizer.
- Wall bracket, instrument panel, or floor mounting as desired.
- Even spacing of the indicator dial and recording chart graduations for ease of reading at high or low flow rates.
- Testing in place at any time with an easily applied manometer test device.
- Change of differential pressure maximum by use of a different float without change of cylinder.
- Maximum differentials of 114" or 64" of water as desired.



Write for Bulletin No. 400 to
Simplex Valve & Meter Company, Dept. 9
6783 Upland Street, Philadelphia 42, Pa.

If it isn't ACCURATE it isn't SIMPLEX

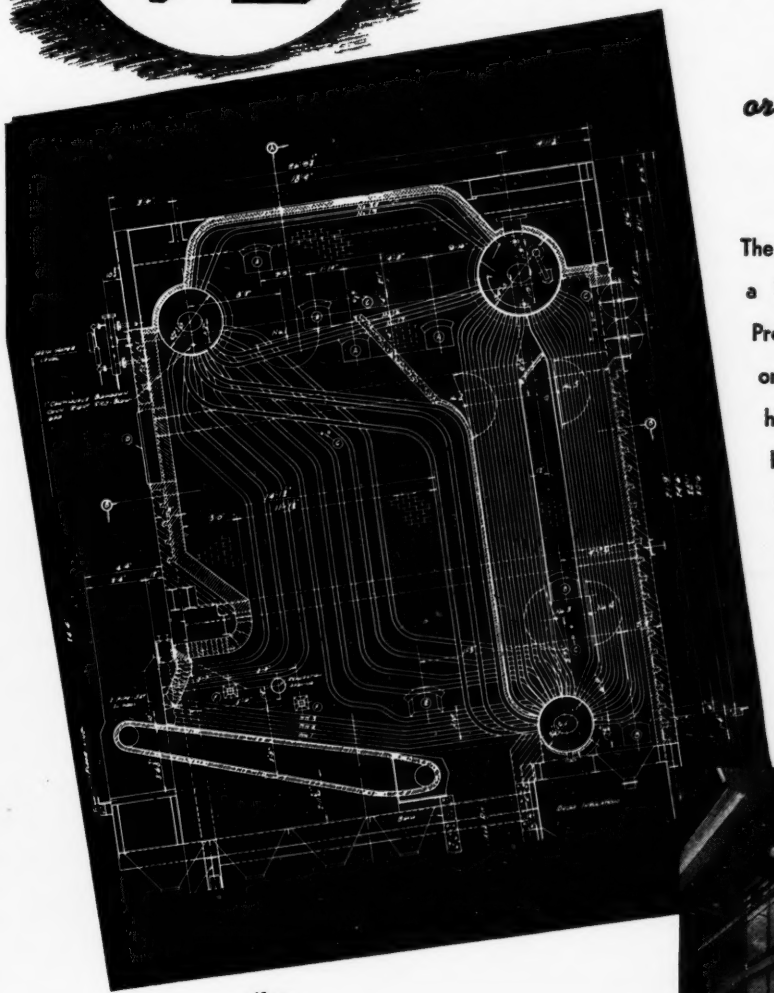
SIMPLEX
VALVE AND METER COMPANY

CLASS **VL**

Vogt

Steam Generating Units

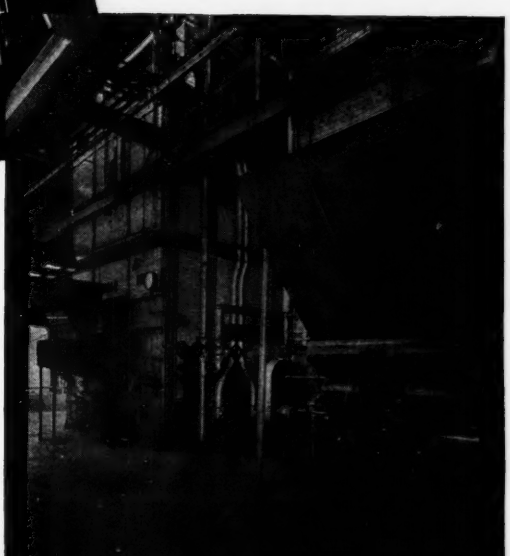
for POWER *or* PROCESSING LOADS, *and* HEATING



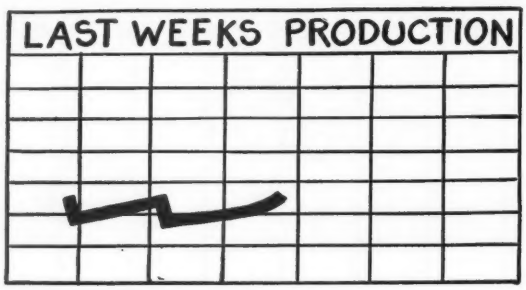
The design provides large furnace volume and a high ratio of radiant heating surface. Proper combustion is assured with any fuel or method of firing. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Vogt Class VL Steam generating units are giving satisfactory service in Hotels, Sugar Refineries, Steel Mills, Furniture Factories, Distilleries, Oil Refineries, and related industries. A bulletin showing typical installations will be sent upon request.

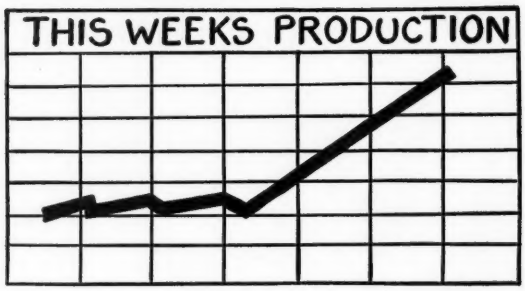
Above:
This 90,000 lbs. steam per hour unit, designed for 475 lbs. pressure, serves the Mansfield Tire & Rubber Co., Mansfield, Ohio.

Right:
Two 515 H.P. units installed in Brown-Forman Distillers Corporation, Louisville, Ky. Plant.



HENRY VOGT MACHINE CO. • 1000 W. Ormsby St., Louisville 10, Ky.
Branch Offices: New York, Philadelphia, Cleveland, Chicago, St. Louis, Dallas





Boost your employee-participation in the Payroll Savings Plan and you boost your production!

You are skeptical? Then consider this logic: The more U. S. Savings Bonds an employee holds, the more secure he feels. The more secure he feels, the greater his peace of mind—the more contented he is with his job. Results? Less absenteeism, less labor turnover, fewer accidents. *End result: increased production.*

And you needn't depend on theory alone. For those company benefits of the Payroll Savings Plan are borne out in the experience of more than 20,000 companies promoting the Plan.

LONG-RANGE BENEFITS, TOO

Bond sales spread the national debt, thus increasing our national economic security. And, of course, what's good for that is also good for you and your business.

The individual Bond Buyer gets back $4, when his Bonds mature, for every $3 he invested. That's a boon for him, and—multiplied by millions of Bond holders—represents a huge backlog of purchasing power that will help assure national prosperity through the years ahead.

IT'S EASY TO BOOST PARTICIPATION

1. See that a top management man sponsors the Plan.

2. Secure the help of the employee organizations in promoting it.

3. Adequately use posters and leaflets and run stories and editorials in company publications to inform employees of the Plan's benefits to them.

4. Make a person-to-person canvass, once a year, to sign up participants.

These first four steps should win you 40-60% participation. Normal employee turnover necessitates one more step:

5. Urge each new employee, at the time he is hired, to sign up.

Nation-wide experience indicates that 50% of your employees can be persuaded to join—without high-pressure selling. All the help you need is available from your State Director, U. S. Treasury Department, Savings Bond Division. He is listed in your phone book.

The Treasury Department acknowledges with appreciation the publication of this message by

POWER GENERATION

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and the Advertising Council.

A STACK THAT REALLY IMPROVES YOUR BOILER *Efficiency*

The Stack, fan and breeching are each only a *part* of an induced draft system. Separately built, they do not always provide the coordinated effort necessary for the most efficient draft that is possible.

Prat-Daniel Fan Stacks, however, offer an integrated induced draft system, combining the three elements of stack, breeching and I.D. fan, into one complete induced draft unit, each component designed to work with the other to produce the highest efficiency.

Prat-Daniel Fan Stacks are built to give your boiler a predetermined draft without excessive "safety factors" necessary with un-coordinated systems. They are completely fabricated and guaranteed by one responsible company . . . a company that has been designing and manufacturing draft-producing equipment for over a quarter of a century.

Write for the Prat-Daniel catalog on Fan Stacks.

Project and Sales Engineers

THE THERMIX CORPORATION

First National Bank Bldg. **Greenwich, Conn.**

Canadian Representative:

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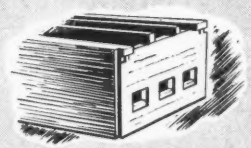
PRAT-DANIEL CORPORATION

EAST PORT CHESTER, CONN.

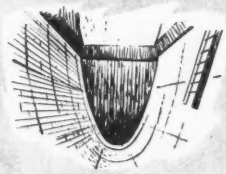
DESIGNERS AND MANUFACTURERS OF POWER PLANT EQUIPMENT FOR OVER 25 YEARS

WHERE TO USE LUMNITE IN POWER PLANTS

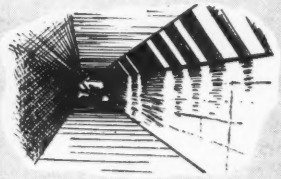
Steel Stack Linings



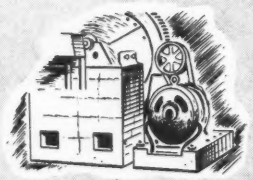
Ash Pit and Cinder Catcher Linings



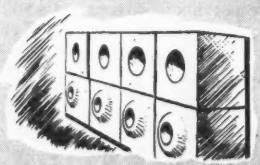
Coal Bunker Linings



Flue and Duct Linings



Overnight Structural Concrete



Castable Refractories

Factory-prepared mixtures of LUMNITE and selected aggregates. Mixed with water on the job, cast into place for door linings, arches, baffles, furnace walls. Special shapes can be cast in molds, ready within 24 hours. Castables to meet different temperature and insulation needs are made by manufacturers of Refractories, sold by their distributors.

FOR RAPID REPAIRS

SAVE TIME, CUT COSTS

with a CASTABLE REFRACTORY

Quickly adaptable to any size, shape or thickness, Castable Refractories made with Lumnite* are economical first aid for emergency repairs.

For baffles, furnace walls, arches, door linings, you get one-piece refractories that reduce heat loss, prevent infiltration of outside air. No shrinkage to bother about. High spalling resistance. Low upkeep.

They're easy to use, too. Add water to the packaged mixture, cast it in place or in a simple form or mold. Large jointless sections are as easy to cast as small special shapes. There's no cutting or fitting. And rapid hardening Lumnite Castables are ready for service in twenty-four hours or less.

You get time-saving, adaptable construction and long, durable service when you specify a Castable Refractory made with Lumnite. You get a balanced, tailor-made refractory that results from the blending of selected materials. You get suitable refractory aggregates with cold-setting, high-strength binder, Lumnite. Castables to meet different temperature and insulation needs are made by manufacturers of refractories and sold by their distributors. For further information, write to Lumnite Division, Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Bldg., New York 17, N. Y.

**"LUMNITE" is the registered trade mark of the calcium-aluminate cement manufactured by Universal Atlas Cement Company.*

PG-L-18

Lumnite Division

UNIVERSAL ATLAS CEMENT COMPANY

UNITED STATES STEEL CORPORATION SUBSIDIARY

135 EAST 42nd STREET • NEW YORK 17, N. Y.

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

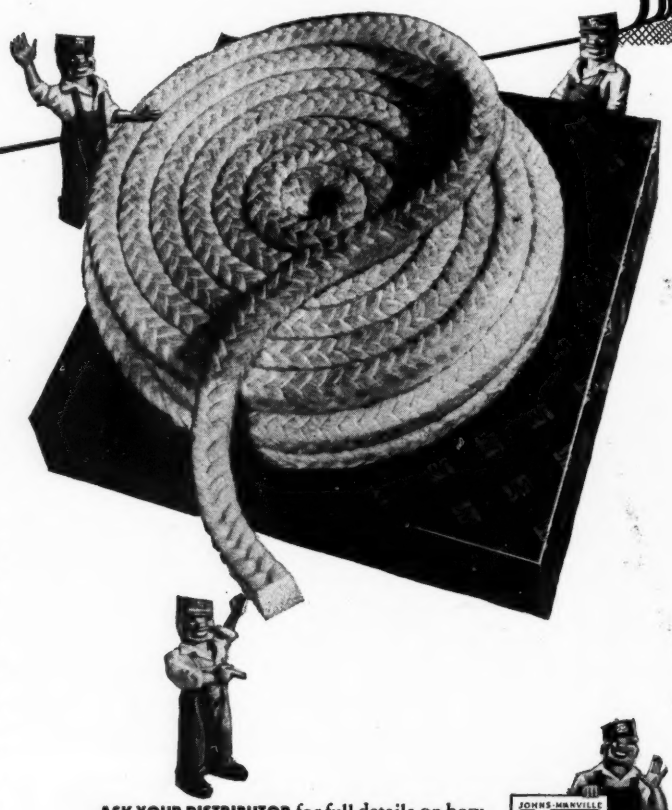
Concentrated Boiler Water is Always CRYSTAL CLEAR"
SEDIMENTATION TANK OF 1930 COCHRANE SOFTENER NOW USED FOR CLARIFICATION AND STORAGE OF BACKWASH WATER
AT the Lockport, Ill. plant of The Texas Company, expansion of steam facilities made necessary provision for water treatment to meet this expansion. A Cochrane Hot Process Softener of 70,000 gph was installed, replacing a 32,000 gph Cochrane Hot Process Softener which had been in use since 1930. Ingeniously, the sedimentation tank of this old softener is now used for the clarification and storage of backwash water. The Two-Stage Softener was adapted because of the high-carbonate high-hardness waters of the region. The Cochrane Two-Stage method combines the use of lime and soda ash for precipitating the bulk of the hardness, with phosphate to precipitate the remaining hardness. Final attainment of "zero" hardness is in the second stage by means of phosphate While the raw water hardness is extremely variable, operations have been so successful that concentrated boiler water is always crystal clear. Write for details on Two-Stage Softening.
COCHRANE CORPORATION
3123 North 17th Street
PHILADELPHIA 32, PENNSYLVANIA
COCHRANE CORPORATION 86 YEARS OF SERVICE 1863-1949
COCHRANE CORPORATION PENNA
COCHRANE
HOT PROCESS WATER SOFTENERS

A Performance report from Connecticut

NAVALON PACKING

"Best packing we ever used..."

"Seven weeks ago Navalon was installed on a salt water pump operating 18 hours a day in this Connecticut power plant. It's still going strong. Longest service previously obtained from flax: 14 days. 'Navalon is best packing we ever used,' states customer."



Typical case histories show J-M's new ramie fiber packing lasts longer!

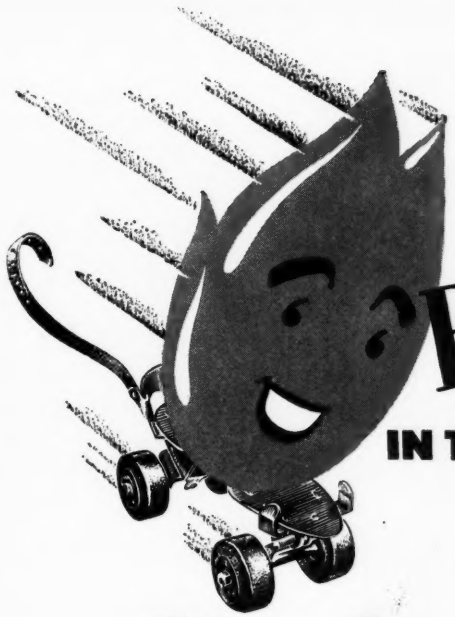
FROM PLANT AFTER PLANT across the country come workaday records—such as the one above—confirming the outstanding performance of Navalon, J-M's new ramie fiber packing for cold-liquid service.

There are good reasons for this. Ramie is nature's strongest, toughest fiber. It is exceptionally resistant to rot and deterioration. And alone of all the natural fibers, its strength actually *increases* when wet.

Add to this the fact that Navalon is made by an exclusive Johns-Manville process which forms these inherently strong ramie fibers into a packing with unique lubricating properties—and you have the secret of its long life. Exhaustive tests have shown that Navalon not only contains more lubricant to begin with, but more important, it retains its lubricant in service. That means longer wear for the packing—but less wear on rods and plungers.

ASK YOUR DISTRIBUTOR for full details on how Navalon can help you keep your packing costs down to a new low. Or write Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville *Packings and Gaskets*



WHAT...LOWER YOUR B.T.U. COSTS IN THE FACE OF HIGH FUEL PRICES?

You Can!

With fuel costs sky high...with competition becoming keener daily...something *has* to be done to get more out of every available B. T. U....*and something can be done!*

Perhaps you *did* carefully survey your fuel economy a few years ago to determine whether an investment in heat exchanger equipment would be profitable.

Perhaps yours was a marginal case and you *did* find that the investment at that time was not warranted. Like others who have *recently* recalculated, however, today you may find that heat exchangers *can* lower your B. T. U. costs substantially...especially because of two noteworthy developments.

1. A vast research program at Ross has boosted the heat conserving performance of traditionally efficient Ross Exchangers.
2. Wide spread Ross standardization has brought about low unit cost.

In combination, these industry-leading feats have, for comparatively nominal investments, pulled down B. T. U. costs for many a plant by eliminating needless and costly waste. This applies not only to first-time users of exchangers, but long-time users as well who are now finding that adding Ross equipment pays off... *quickly!*

Ross Heater & Mfg. Co., Inc., Div. of American Radiator & Standard Sanitary Corp., 1428 West Ave., Buffalo 13, N. Y. In Canada, Horton Steel Works, Ltd., Fort Erie, Ont.

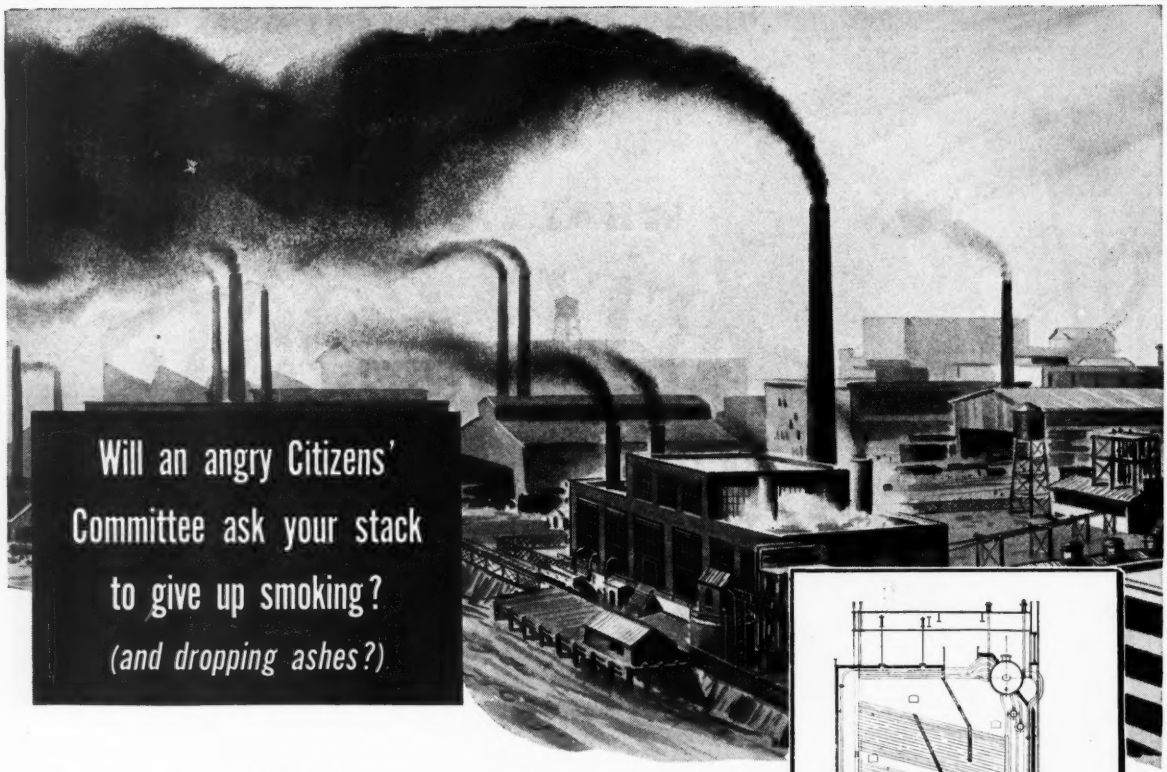
★ Whether or not you have made a recent heat consumption survey, why not consult a Ross heat exchanger engineer now? No obligation in finding out from him how to increase the B. T. U. return from every fuel dollar you spend.

ROSS

EXCHANGERS ... ***MAKE OTHER PRODUCTS BETTER***

Serving home and industry

AMERICAN STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILER • ROSS HEATER • TONAWANDA IRON



Will an angry Citizens' Committee ask your stack to give up smoking? *(and dropping ashes?)*

How does your stack stand in your community? Is it acceptable and accepted, or a frequent cause of community contempt?

Few plants today can risk the indignation of their neighbors.

You can do something about it.

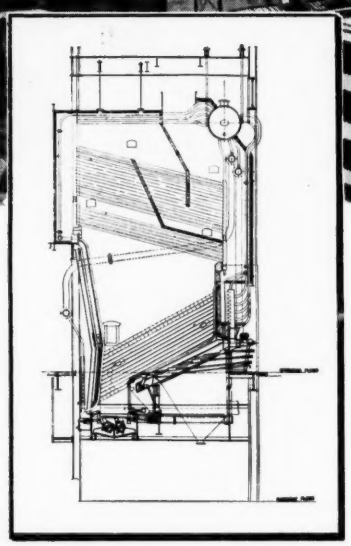
It is a fact—though sometimes overlooked—that properly designed furnaces and multiple retort underfeed stokers are operating satisfactorily to all in the heart of cities *without fly ash collectors.*

It is also a fact that multiple retort underfeed stokers at low ratings create no smoke problem at all. Think of it—no worries about smoke even at low ratings. Remember, too, that the elimination of fly ash collectors means lower draft losses and frequently eliminates the need for induced draft fans.

Taylor Multiple Retort Underfeed Stokers of adequate grate area deliver over 90% of the ash to the ashpit. Most of the particles which do leave the furnace can easily be collected without *expensive* dust recovery equipment.

So why use your community for an ash tray? It is so easy to prevent or end your smoke and fly ash difficulties with Taylor Stokers. They burn coal from Nebraska to the Atlantic, as well as in Canada, Britain and the Continent.

Whether you're converting your present combustion system, or building from scratch, Taylor Stokers adapt to present or future conditions, type of equipment, growth and change of power service requirements. For efficient, low-cost steam production and freedom from objectionable stack discharge, get full details of Taylor Stokers today. Our 20-page, fully illustrated Catalog is yours for the asking. Send for it now.



Washington, D. C., is extra fussy about the stack nuisance. Modern heating plant in Washington, D. C., originally installed 2 water-cooled Taylor Multiple Retort Underfeed Stokers—recently ordered a third. Each of 2 units handles 150,000 lbs. per hour normal steam flow, and 240,000 lbs. per hour peak loads. Taylor Stokers meet the smoke requirements of any city.

FREE *This "fact-packed" booklet on the improved Taylor Stoker. Write for your copy today. No obligation.*

TAYLOR STOKER

PRODUCT OF

AMERICAN ENGINEERING COMPANY

Dept. 12, 2408 ARAMINGO AVENUE, PHILADELPHIA 25, PENNSYLVANIA

New York Office—75 West Street, N.Y. 6, N.Y.

In Canada: *Affiliated Engineering Corporations, Limited, Montreal and Toronto*

OTHER Æ PRODUCTS—Perfect Spread Stokers—Lo-Hed Electric Hoists & Car Pullers—Marine Deck Auxiliaries—Hele-Shaw Fluid Power

HOW DOES Your Plant SCORE ON THESE WATER TREATMENT SERVICES?

Whether you generate 100 or 10,000 hp in your plant, you should be getting all the scientific methods . . . all the benefits of "central station" water treatment. Below is the Bird-Archer 8-Point System of Water Treatment, developed through a half century of experience. Read this list carefully. Think about it. Then score your present methods against the carefully planned, individually-geared Bird-Archer Water Treatment System.

BIRD-ARCHER WATER TREATMENT SYSTEM			
1. Plant survey .....%	*2. Study of all available water with particular relation to use* .....%	*3. Development of treatment and control systems* .....%	*4. Furnishing properly prepared treatment materials* .....%
5. Specifying any equipment that may be necessary .....%	*6. Instructing plant staff in the operation and control of the treatment system* .....%	*7. Continuous supervisory service* .....%	*8. Laboratory Service for scientific analysis* .....%
ALL OR ANY PART OF THIS SERVICE IS AVAILABLE TO YOU			

How did you score? Do you now have an effective program of water treatment and control . . . a system which encompasses all the aspects of this highly technical field? Bird-Archer will provide you with all of these services . . . keep your operations under the closest scrutiny . . . make certain their individually adapted treatment methods are followed precisely. Yet, in all likelihood, Bird-Archer Water Treatment will cost no more than what you are now paying.

Profit by a searching discussion of your needs with a Bird-Archer Field Engineer. For a consultation without obligation *plus* a *free* basic survey of your requirements, simply fill out coupon and mail today.

BIRD·ARCHER

WATER TREATMENT

THE BIRD-ARCHER COMPANY • 400 MADISON AVE., NEW YORK 17, N. Y.
PHILADELPHIA, PENNSYLVANIA • CHICAGO, ILLINOIS • MONTREAL, CANADA
CALDERAS Y ACCESORIOS, S. A. AMSTERDAM 291, MEXICO, D. F.

THE BIRD-ARCHER COMPANY, 400 MADISON AVENUE, NEW YORK 17, N. Y

Gentlemen: Please have your Field Engineer call and make a free basic survey of our water treatment requirements. I understand there is no obligation.

NAME _____ POSITION _____

COMPANY _____

ADDRESS _____

BA-149

WHY DO Genuine
BELMONT FLAX PACKINGS
Seal Securely and Last Longer?

1 We possess complete facilities for their manufacture.

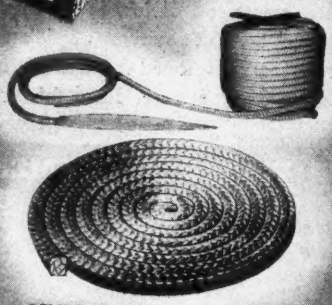
2 Belmont controls the purchase of the raw flax fibre. It is carefully selected for length, strength and softness.

3 The steps of hackling, spreading and drawing of suitable rovings are all accomplished within the Belmont plant.

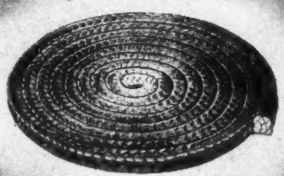
4 The braiding of rovings; lubricating and finishing of the completed packings are under expert supervision.

Try them . . . in the blue box with the orange-colored trade mark.

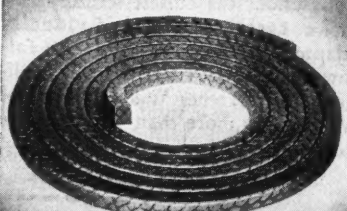
Distributors located in every large industrial center, are ready to serve. Or, write on your company letterhead for catalog No. 40.



BELMONT 401X (Coil or Reel) — Best quality Line Flax Fibre of selected length and strength.



BELMONT 404 (Coil) — Pure flax fibre of next fibre length to Line Flax.



BELMONT 303 (Coil) — Line Flax of selected quality, with coarse and short fibres extracted. Treated with waterproof lubricant and surface graphited.

THE BELMONT PACKING AND RUBBER CO.
Butler and Sepviva Streets
Philadelphia 37, Pa.

THERE'S A BELMONT PACKING FOR EVERY SERVICE
Steam, Water, Oil, Gas, Air, Brine, Refrigerants, Fuels, Acids, Alkalies, Ammonia, Solvents, Sewage, Gases

CATALOG LIBRARY

This monthly list of the latest standard catalogs and bulletins is designed to aid the engineer in maintaining his permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the Helpful Bulletins coupon in requesting these copies.

BOILERS AND AUXILIARIES

201 **Working Pressure Data Card**—Maximum allowable working pressures for water tube and fire tube boilers are compiled in a handy reference table, Technical Data Card No. 113 A. It lists pressures in pounds per square inch for seamless and electric resistance welded carbon steel tubes or nipples for different diameters and gages of tubes conforming to ASME specifications. Chart covers 2 letter-size pages, is printed on firm stock, and punched for use in binder. The Babcock & Wilcox Tube Co.

202 **Blast Furnace Gas Burner Bulletin**—Said to be the first published on the subject. Bulletin No. 500, 4 pp, describes operation of these burners and discusses their adaptability for use not only with waste fuels, but also in combination with auxiliary fuels and by means of auxiliary fuels alone. Contains pictures of gas burner installations and cross section drawings of various other types of burners for waste and primary fuels. Peabody Engineering Corp.

203 **Steam Generating Equipment**—Bent-tube and straight-tube boilers of several classes are described in detail and illustrated by photos and drawings in this 4-pp bulletin. Also illustrated are some of the valves, heat transfer equipment and refrigeration equipment manufactured by company. Henry Vogt Machine Co., Inc.

203A **Power Plant Equipment**—Catalog 200, 20 pp, presents a line of fans, fan stacks, tubular and duplex dust collectors, multicyclones, and recirculators. It discusses and illustrates applications for this equipment, explaining its operation and construction. Contains many photos and sectional drawings. Also lists well-known plants where this equipment is currently in use. Prat-Daniel Corp.

VALVES, TRAPS, PIPING

204 **Pipe Distribution System Data** — "Engineering Distribution Data for Underground Steam Distribution," is the title of Section 480-2, 34 pp, of practical usefulness to those who deal with problems involved in insulated piping distribution systems. It covers layout of the route and methods of estimating steam loads, includes steam flow charts and tables, and gives properties of steel pipe, copper water tube piping and saturated steam. Also gives specifications of steam and hot water distribution piping with prefabricated pipe conduit. It's illustrated with photos of field installations and industrial applications of insulated pipe units, also sketches showing method of making field closures. The Ric-Wil Co.

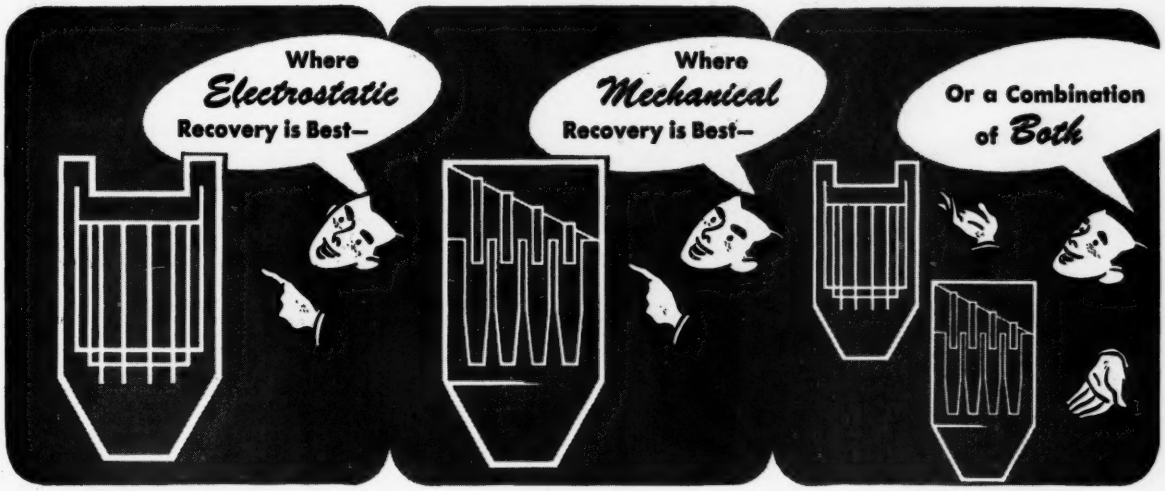
205 **Piping Materials Catalog**—Corrosion resistant valves and piping materials are covered in illustrated circular No. 320, 32 pp. Contains information on manufacturer's complete line of valves, fittings, fabricated piping and pipe coils to meet a wide range of corrosive conditions. Listing includes both photos and cutaway drawings of models, complete specifications, sizes and prices. Includes a description of alloy metals used and a corrosion questionnaire. Also included are several pages of condensed recommendations on the selection of piping materials according to service requirements as well as a pictorial chart showing basic types of valves with names of their component parts. Crane Co.

206 **Steam Specialties**—Here is a collection of bulletins covering manufacturer's line of thermostatic steam traps.

This is the UNIQUE ADVANTAGE

Western Precipitation provides for simplifying YOUR Fly Ash Recovery Problems..

If you are not sure whether yours is a job for Cottrell or mechanical separation methods, you'll get an unbiased recommendation from Western Precipitation Corporation because this organization designs, engineers and installs BOTH!



THE *COTTRELL* ELECTRICAL PRECIPITATOR

Western Precipitation is the organization that pioneered the first commercial application of the now-famous Cottrell Electrical Precipitator. And its unique advancements and refinements in the basic methods, developed through more than 38 years of first-hand experience in Cottrell installations, assure you of the most modern in electrostatic recovery equipment from Western Precipitation Corporation. Cottrells handle dust, fume, fly ash, mists and other suspensions with high efficiency.

THE *MULTICLONE* MECHANICAL COLLECTOR

Companion to the Cottrell is Western Precipitation's widely used *Multiclone* equipment which offers far-reaching advantages in the mechanical separation of solids from gases. Its unique vane design makes possible multiple *small*-diameter separating tubes that combine high recovery efficiency with maximum compactness, minimum maintenance and wide-range adaptability to varying installation requirements. For mechanical recovery of solids, *Multiclone* is unsurpassed in operating efficiency, economy and installation simplicity.

COTTRELL AND MULTICLONE

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you can benefit by Western Precipitation's leadership and long experience in the science of recovering suspensions of all kinds—both liquid and dry—from gases, hot and cold. Western Precipitation Corporation installed the first successful Cottrell which is still in operation after 35 years of service. No matter what your industry, Western Precipitation is prepared to serve you in *all* parts of the world. Write, wire or call our nearest office.

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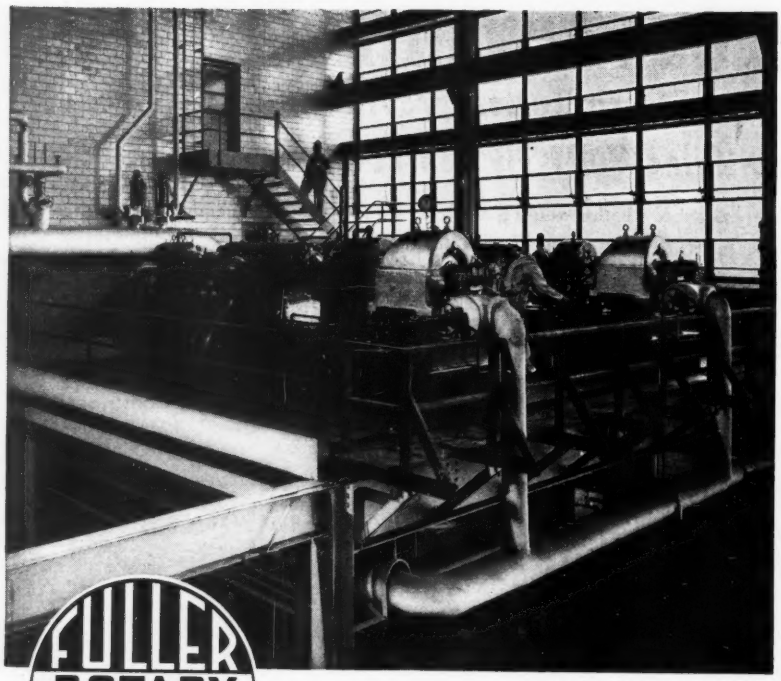

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in

SHERWIN-WILLIAMS

NEW BOILER HOUSE

Two Fuller Rotary Two-stage Compressors are installed in the new boiler house of The Sherwin-Williams Co., Chicago, shown above.

These compressors furnish air for both factory and power-house service. Each has a capacity of 1592 c.f.m., free-air, at 120-lb. pressure, driven by 350 hp. turbine, equipped with speed reducer, to operate at 575 r.p.m.

Fuller Rotaries are ideal units for any industrial plant. They are built in single and two-stage for capacities to 3300 c.f.m., actual free-air delivery, 125-lb. pressure; vacuums to 29.90-in. (referred to 30-in. barometer).

Bulletin C-5 illustrates and describes these machines. We will gladly send you a copy.

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C-180

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inverted bucket steam traps, float-thermostatic steam traps, radiator traps and valves, alternating receivers and lift traps, self-operated temperature regulators, air venting equipment, water blenders, strainers. All equipment is illustrated by photos, its operation and applications discussed, and its capacities, dimensions and prices listed. Sarco Co., Inc.

207 **Pipe Hanger Catalog** — Ninety-page Catalog 10-D is a valuable buyer's guide for adjustable pipe hangers and supports. Covers hangers for attachments to pipe and to structure, hanger assemblies, spring hangers, hanger rods, pipe supports and related equipment. Each type described and illustrated by photo and dimensional diagram and listed with dimensions and prices. Catalog also includes standard specifications, photos of installations and terms of sale. Indexed for quick reference; punched for filing in binder. Grinnell Co., Inc.

208 **Valves Bulletin**—A new catalog section 12-H describes all types of the company's cast steel pressure-seal bonnet valves. Information on choosing the best size valve for your service is given in one page of the booklet under the title, "Correlation of Valve Size and Pressure Drop." Design and construction advantages of the valves are given and tables of pressure and temperature ratings. Details of design including operating mechanism, body design, disk piston, and other features are explained. Dimensional details are given in tabular form accompanied by dimensioned line drawings. A standard materials specification table is presented. Edward Valves, Inc.

209 **Rubber Expansion Joints** — This 8 page bulletin AD 137 tells about the application, construction, styles, service and advantages of the company's line of rubber expansion joints. Other information given, includes "How To Order" and a table of dimensions which is accompanied by dimensioned line drawings. The bulletin is well illustrated. The Garlock Packing Company.

210 **Control Equipment** — General Catalog 001, 30 pp, is devoted to measuring and control equipment for water and sewage works, power and processing industries. Catalog illustrates and describes in detail: venturi tubes and meters, controllers, gages, manometers, pitot equipment. Includes capacity tables, dimensional data, specifications, layout drawings. Simplex Valve and Meter Co.

210A **Rubber Expansion Joints**—Four-pp Bulletin D features rubber expansion joints for handling many types of fluids under conditions of vacuum, pressure and temperatures to 250F. Gives specifications, sizes and tells applications. Also illustrates design principle of these joints. Goodall Rubber Co., Inc.

HEATERS, HEATING

211 **Space Heaters**—Bulletin 523, 12 pp, covers forced air space heaters, direct-fired by oil, gas or combination fuel and ranging in output from 400,000 to 2,000,000 Btu, for comfort heating, year-round ventilating, tempering make-up air, process drying and heat curing. It discusses their design and principle of heat distribution and lists 18 reasons why these heaters are recommended for open space heating. Includes specifications, capacity and dimension tables, sketches illustrating operating principles and construction details and photographs showing the heaters in use. Dravo Corp.

212 **Fan Heater Bulletin**—Here's a 2-pp illustrated bulletin (No. 109) on a new high pressure steam fan heater designed for complete utilization of both sensible and latent heat of high pressure steam. One page is devoted to description and photos of the heater. Other page contains a sketch in color showing how the heater works. Niagara Blower Co.

213 **Heating Element Data**—Bulletin No. 20, 8 pp, contains detailed capacity and dimension tables on manufacturer's "Paracoil" heating elements. Illustrations and descriptions provide instruction for installation of heating elements and diagrams show six commonly used installation arrangements of hot water generation using these heating elements and storage tanks. Includes conversion table for steam and temperature conditions for determining capacity of any size heating element. Davis Engineering Corp.

214 **Steam Humidifiers**—Bulletin 1771 describes the company's steam humidifiers for automatically controlling relative

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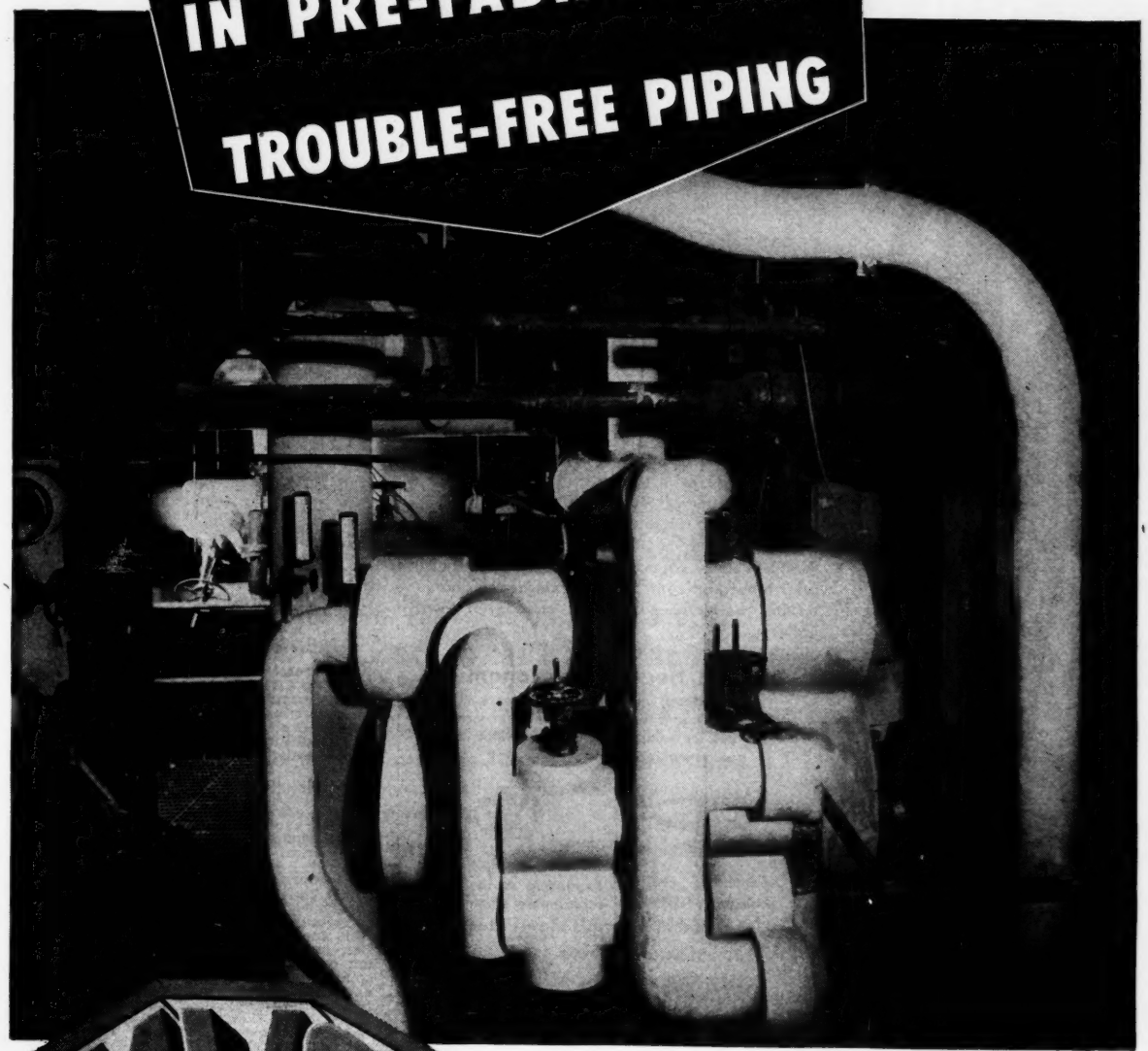

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humidity for the prevention of dry air damage to hygroscopic materials such as paper, leather, wood, cork, foodstuffs and other materials in storage or in process. The bulletin also describes the effect of relative humidity on human comfort and help and explains how maintenance of proper humidity will eliminate the fire and explosion hazards of static electricity where inflammable dust, vapors or liquids are present. Tables and charts are included on desirable relative humidity in various industries. Two useful sections of the bulletin are "How to Select," and "How to Install," both of which are accompanied by excellent line drawings presented in two colors. Armstrong Machine Works.

215 **Tubular Heat Exchangers**—Bulletin 916 is a particularly informative 32 page bulletin which has "just been issued." The bulletin describes the present designs of the company's tubular heaters, coolers, condensers and heat exchangers and their distinctive features. The various types of shells, tube bundles, stationary heads and floating heads are fully explained, together with statements of the particular services for which each is suitable. An additional helpful feature of the bulletin are tables of the characteristics of tubing, the thermal resistance of tubes and pipes of many different metals and alloys, and the specific gravity and pounds per gallon corresponding to degrees Baume and degrees API. Also presented is a chart of the specific heats of midcontinent crude oils and the charts for solving the MTD formula with correction factors for other than countercurrent conditions. The Griscom-Russel Co.

215A **Determination of Steam Quality**—Bulletin 41 is an 8-pp discussion, illustrated with charts and drawings, of procedures for accurate diagnosis of carryover in steam. The design and operation of proper sampling nozzles is explained along with the methods of testing steam quality. Data includes a table of dimensions of sampling nozzles for pressures above atmospheric for use in extra heavy pipes, and graph showing correction factors for ammonia and carbon dioxide in degassed condensed steam. National Aluminate Corp.

TREATMENTS, PREVENTIVES

216 **Protective Coating**—Bulletin 1540, 4 pp, is devoted to a corrosion resistant coating for cold, wet surfaces. Tells its protection against corrosive effects of natural fresh and salt water, cold acid and alkali solutions, acid fumes and atmosphere under shelter. Discusses in detail the use of this coating in water storage tanks and in condensers. Tells how coating should be applied and how to order it. Bulletin also includes photos and description of equipment recommended for use in applying the coating. The Dampney Co. of America.

217 **Corrosion Analysis**—Excellent working data on galvanic corrosion is contained in this 8-pp technical study of corrosion by concentraion cells, reprinted from Inco Corrosion Reporter, Vol. 3, No. 1. Discusses concentration cells, the metal-ion cell type, oxygen cell type, reversible concentration cells, their practical aspects and some rules for minimizing or preventing concentration cell corrosion. Illustrated with sketches showing conditions which accelerate corrosion. The International Nickel Co., Inc.

218 **Turbine Blade Deposit Study**—Identification and prevention of steam turbine blade deposits and boiler water conditioning to prevent such deposits are discussed in the new 16-pp illustrated Bulletin 28B7030. Describes x-ray diffraction methods employed by the company for identification purposes and the results obtained. Tables list the partial chemical analyses of deposits containing sodium disilicate, occurrence data on compounds found, composition of turbine deposits from turbines operating at various throttle pressures and temperatures, and comparison of compounds found in turbine blade deposits with boiler operating pressures. This is the 10th in manufacturer's series of engineering bulletins. Allis-Chalmers Mfg. Co.

219 **Boiler Water Manual**—Factual information on standard methods of applying chemicals in the treatment of water for boilers is presented in this 16-page technical bulletin, called Standard Method 122. Discusses pretreatment of raw water, application of chemical feeding to pretreating operations and both constant rate

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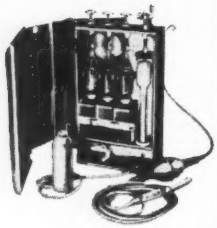

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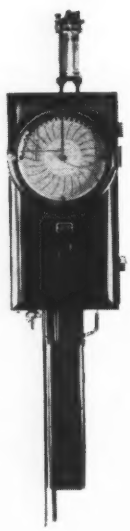

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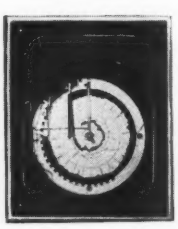

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and flow responsive feeding direct to boiler drum and to feedwater systems. Also discusses condensate returns, flushing periods, condenser cooling water treatment and chemical tanks. Illustrations include photographs of two feeders and diagrams of the various methods described. Punched for filing in ring binder. Proportioneers, Inc.

220 **Water Conditioning Bulletin**—This is an eight-page discussion of water and chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition and application. Also discusses special purpose chemicals. Wright Chemical Corp.

221 **Antifoaming Compound**—This new technical bulletin covers the company's latest product known as Antifoam 8. With the accelerated rate of operation in many power plants today, foaming from either chemical or mechanical origin has become one of the prime problems in boiler operations. This technical bulletin presents reasons for foaming and deals with the chemical causes, especially the application of antifoams to elimination of carryover from these causes. After discussing the causes for foaming the bulletin goes on to describe the proper dosage and feeding and results obtained from the use of Antifoam 8. E. F. Drew & Co., Inc.

222 **Corrosion Resistance of Nickel Alloys**—Technical Bulletin T-3 contains 44-pp of illustrated information on the resistance of high nickel alloys to corrosion by sulfuric acid. Although technical in nature, it is written so as to be readily understood by non-technical staffs. Performance of 30 nickel-bearing materials in a wide range of service is discussed, and there are 86 tables and 33 graphs and photos in addition to text. Problems involving a wide range of operations from the pickling of steel to petroleum refining and textile processing are covered. The International Nickel Co., Inc.

223 **Magnesium Anode Data**—General information on magnesium anodes for cathodic protection of industrial equipment, pipe lines and other metal structures is provided in 5 letter-size sheets. It covers applications of cast, packaged, flexible ribbon and extruded magnesium anodes. This bulletin gives composition of magnesium alloy used and includes ratings, dimensions, sketches and prices. Dowell Inc.

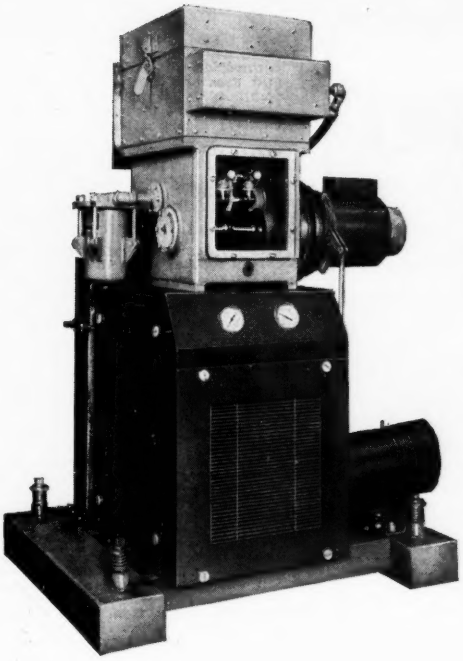
224 **Anti-Foam Treatment** — This 4-pp bulletin covers a new formula in powder form to be applied along with anti-scale treatment for improving steam quality, controlling scale in boiler feed system and sludge conditioning. It discusses the problem of steam contamination and explains the action of this polyamide anti-foam treatment. Tells how it should be applied and gives dosage requirements. A discussion of its advantages is accompanied by photos showing the effect of polyamide action on a boiling dilute Nacconol solution. Dearborn Chemical Co.

225 **Boiler Corrosion**—A 12 page article discussing the cause and prevention of corrosion in boiler systems is presented in Betz Technical Paper No. 111 titled "Corrosion: Its effect in Boiler Systems." The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity and physical factors are evaluated. Numerous illustrations, graphs and tables aid in understanding the article. W. H. & L. D. Betz.

226 **Application Data Bulletin** — Titled "The Aroclors," chlorinated biphenyl and chlorinated poly-phenyls, this booklet describes the unique properties which enables this material to fulfill certain requirements. The Aroclors have won a place in the electrical insulating field and in such widely differing applications as non-flammable hydraulic media, high-temperature and high-pressure lubricants, heat-transfer and expansion media, sealing compounds, adhesives and protective coatings, including plastics, pigments, lacquers, paints and varnishes. This booklet contains 28 pages and presents the combined information gathered by the company from what it believes it to be reliable and dependable sources. Monsanto Chemical Co.

ELECTRICAL

227 **Electrical Diagram Guide**—The purpose and use of electrical diagrams supplied with switchgear equipment are explained in Bulletin GET 1293A. It was written to help those who install, operate or maintain switchgear equipment make



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the best use of the diagrams that come with such equipment. Discusses in detail one-line, elementary, connection and interconnection diagrams. It tells their scope and uses and illustrates symbols used and common variations and explains ASA device function numbers and conventions. General Electric Co.

228 **Transformer Buyers Guide**—An excellent technical manual on instrument transformers is this 80-page catalog, GEA-4626B. Contains descriptions, photographs and index of ratings and construction for indoor and outdoor potential transformers, indoor and outdoor current transformers, outdoor metering outfits and portable potential and current transformers, according to cycles. Dimensions, prices and shipping weights are included with listing of each type, as is reference to manufacturer's bulletin dealing with that type of transformer. Index of types shows voltage and frequencies. Also included are tables showing mechanical and thermal limits of current transformers. Book has firm covers and ring binding for long-time reference use. General Electric Co.

229 **Induction Motor Bulletin**—A four-page illustrated folder, PB 7000-1, describes manufacturer's new two-pole, 200 to 3500 hp induction motor of fabricated steel construction, available in enclosed or separately ventilated types. Construction features are discussed in detail and illustrated with photographs. Elliott Co.

230 **Synchronous Generators**—This Bulletin, 05B6139A, describes construction features and electrical characteristics of engine-type synchronous generators in standard ratings from 25 to 10,000 kva and for standard speeds from 100 to 600 rpm, for Diesel, steam or gas engines. Also describes and illustrates mechanical construction of stators and rotors and discusses machine characteristics, ratings, voltages, frequencies, phases, temperature rises and operation at high elevation. Illustrations show typical installations. Available control accessories are listed, as are manufacturer's other products and territorial sales offices. Allis-Chalmers Manufacturing Co.

231 **Induction Motors**—Twelve-pp Bulletin GEA 3580D covers induction motors, the open, dripproof type, 1 to 2000 hp. Cites performance records of several of these motors, and explains and illustrates construction features. Stresses the easy installation and maintenance and smooth operation of the motors. Contains photos of several of them in use. Apparatus Dept., General Electric Co.

PUMPS, COMPRESSORS, ENGINES

232 **Condensers**—Bulletin 441-C, 28-pp, covers in detail every phase of manufacturer's line of condensers—their simplicity of design, accessibility, construction features. Illustrated with photos and drawings showing complete assemblies, parts, principles of operation. Bulletin also discusses emergency replacements, service and maintenance facilities available, and auxiliary equipment. Includes condenser tube data, pressure-conversion tables. Condenser Service & Engineering Co.

233 **Chemical and High Pressure Pumps**—Catalog 146, 30 pp, covers controlled volume pumps for chemical and high pressure service. Discusses their general applications, tells how they work, and explains manual stroke adjustment and automatic control. Contains photos and descriptions of these pumps in a wide range of capacities. Technical data includes capacity pressure selection tables, a three-color table showing materials of construction suitable for handling more than 175 chemicals. Also gives dimensions, shipping weights and provides a prepared form for requesting quotations. Milton Roy Co.

234 **Compressor Selection Chart**—Here's a new selection chart, based on normal applications handling air with atmospheric intake pressure. It simplifies selection of proper size compressor for average industrial use, with quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute and shows recommended compressor bore and stroke in inches. Chart covers two letter-size pages. Worthington Pump and Machinery Corp.

235 **Air Compressor Lubrication Manual**—Valuable information on air compressor maintenance is contained in this 40-page book on the lubrication of air compressors, second edition. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and their applications, lubrication requirements operating

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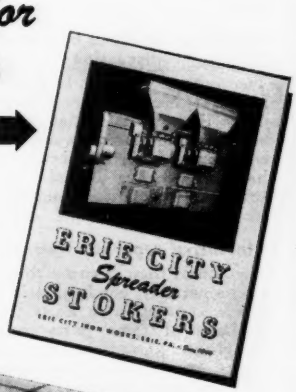

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HEAT TRANSFER

Volume I

By Max Jakob

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The author then discusses the processes separately, conduction in Part C and convection in Parts D and E. Each of these parts contains straight solutions, similarity treatments, graphical and experimental methods, and all other important phases of the subject.

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Only a small amount of the important work on heat transfer done in Germany from 1910-1935 has been available to American scientists and engineers. The author presents the main contents of this literature, including the most important derivations, in such detail that study of the original papers will rarely be necessary.

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hints, oil requirements, storage and care of compressor oils, and safety precautions. All discussions are illustrated with large, clear photographs and drawings showing construction and operation of compressors, their lubricating systems, etc. Cities Service Oil Co. (In the South, Arkansas Fuel Oil Co.)

235A **Steam Pumps**—This is manufacturer's collection of bulletins covering all types of centrifugal and reciprocating pumps for a wide range of industrial uses. Contains more than 80 pp in all and includes photos, dimensions, specifications, ratings and application data. Warren Steam Pump Co.

236 **Steam Engine Governor Data**—This new bulletin No. 502, describes the company's Type EN fully enclosed self-lubricated governor which is described as giving "precise, dependable engine speed control." Illustrations of the unit are presented and a parts list, accompanied by a sectional diagram is given. One section "Installation and Care" tells how to assemble governor to engine cylinder and how pulleys should be proportioned, the proper type of belt for use with the governor, correct lubrication procedure, method of packing and other data. Troy Engine & Machine Co.

237 **Turbine Catalog Collection**—This is a valuable collection of bulletins in loose-leaf form. They cover a complete description of manufacturer's solid wheel turbines and feature cross section drawings of typical units for both moderate and high steam pressure conditions. Also provides a description of an axial flow impulse, both single and multi-stage, and complete data on speed increasing and speed reduction gears. The Terry Steam Turbine Co.

237A **Velocity Stage Turbines**—Catalog 82-19R, 8 pp, features turbines for mechanical drives designed to operate under all inlet steam conditions up to 600 psig and 750 F. Gives complete specifications, dimensions and includes chart showing how to estimate turbine sizes. Illustrations include cutaway view, photos of parts. Speed governor and regulating valve, and emergency governor and trip valve are described in detail. De Laval Steam Turbine Co.

INSTRUMENTS AND CONTROLS

238 **Combustion Instrument Catalog** — Twelve-pp Condensed Catalog 49-687 describes briefly and illustrates instruments and controllers for both boiler rooms and industrial processes. Equipment covered includes automatic controllers, meters for indicating content of flue gases, draft gages, flow meters, gas analyzers and recorders, and combustion testing equipment. The Hays Corp.

239 **Water Gages — Eight-page Bulletin E-1** covers line of water gages for stationary and locomotive boilers, marine and refinery service and tanks for all pressures and temperatures. Listings include photos of all gages, sizes and construction details. Bulletin S-2, four pages, covers gage glasses, glass guards, sight flow indicators and related equipment. Ernst Water Column & Gage Co.

240 **Temperature Measuring Instruments** —For all those responsible for the safe operation of electric power equipment, this company has just issued a revised 34 page catalog ND4-33-461 describing the company's instruments for measuring the temperature of generators, motors, condensers, transformers, etc. The bulletin covers a wide variety of instruments, portable and automatic indicators, for checking in any order on temperatures. Reference also is made of new and specialized instruments for measuring in rapid succession a number of bearing temperatures. Leeds & Northrup Co.

241 **Combustion Control**—Bulletin 102-D describes this company's air operated combustion control. Containing 32 pages and bound in a heavy paper cover, the booklet describes completely the application to boilers fired with oil burners, stokers, to furnace draft control and points out its adaptability to any plant layout. Descriptions of the controllers themselves along with integral parts of the units are given. Typical installations of pulverized coal fired boilers are presented in a separate section of the bulletin. Installations on stoker fired boilers and on oil fired units also are given. Bailey Meter Company.

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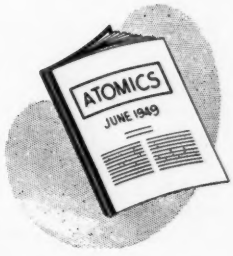

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242 Boiler Water Level Control — Bulletin 487 describes completely the installation of boiler water level control equipment at the Blackhawk Generating Station, Wisconsin Power & Light Company. Photographs of the installation are presented as is a schematic layout of the entire station along with tabulated significant data. A large, full-page cross section of the B & W Type FH integral furnace boiler is presented and other drawings and photographs show the accompanying equipment. Northern Equipment Company.

243 Multiple Signal and Alarm Systems —Panalarms, multiple signal and alarm systems adaptable to all types of industrial and power plant applications, are described in 12-page, letter-size, illustrated Series 300 Panalarm bulletin. Gives details of operation, shows types for panel and well mounting, wiring circuits, operation sequence, dimensions of units. Shows how Panalarms indicate by light and horn signals, acknowledging button, for normal and abnormal conditions. Systems are supplied in multiple units up to 12 in single cabinet; extra space for spare units; provisions for future additions; simple field wiring. Price list included. Panalarm Products, Inc.

244 Instrument Handbook—"Modern pH and Chlorine Control" is a 100-pp catalog containing a great deal of valuable information in addition to covering manufacturer's line of scientific instruments and accessories. It explains the meaning of pH control, the electrometric and colorimetric methods of determining pH, and gives values of common acids, bases and foods, as well as maximum capacities of buffer systems. It also discusses in detail the applications of pH and chlorine control in air conditioning, water treatment, boiler water and many other industrial applications, recommending instruments and solutions. Instruments are illustrated by photograph, their functions described and sizes and prices given. W. A. Taylor & Co.

DUST COLLECTING

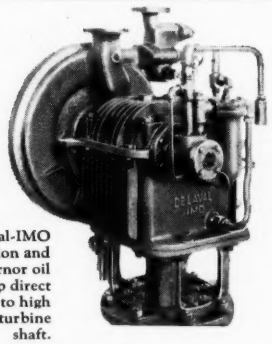
245 Dust Collectors — Dust collecting equipment for power plants, foundries, cement plants and similar industries is the subject of Bulletin No. 1428, 26 pp. Contains many photographs of installations, also photos showing equipment being tested in company laboratories. Discusses services offered by manufacturer in analyzing individual installation requirements and recommending equipment for the job. American Blower Corp.

246 Filter Catalog—Manufacturer's line of filters for air and other gases, liquids, chemicals and special applications is presented in 44-pp Form 450. Its pictorial index is followed by a brief discussion of the applications of pipeline filters, air intake filters, liquid filters and ventilation and air conditioning filters. Each type illustrated and described in detail. Capacities, specifications, sizes given. Includes layout drawings, a listing of some of the filtering media available, installation data on panel filters, and selection chart for dry type filters. Dollinger Corp.

MATERIALS HANDLING

247 Continuous Weighing of Dry Materials—Bulletin E4-550 describes the company's new meter for continuously weighing and totalizing the flow of dry materials on conveyor belts. The meter can also be used for the automatic proportioning and controlling of dry or liquid feeders for secondary ingredients. The bulletin describes how the device operates, how it is constructed and gives various features. A double page spread, printed in two colors, presents a typical installation of the unit on a belt conveyor. Blueprint type drawings illustrate various applications for the continuous weighing and/or controlling and proportioning and flow of dry or liquid materials. Builders-Providence, Inc.

248 Dry Materials Conveyor — Bulletin F-H-1 describes this company's revolutionary type of conveyor designed for the handling of fine, dry materials. The book, which contains 12 pages, presents excellent installation views of the conveyor, and also drawings which illustrate construction and method of operation. The bulletin points out that the conveyor has no moving parts and that it has no hazards to workmen, is silent in operation, requires no lubrication and can pass around obstacles. Fuller Company.



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248A **Coal Scale Data Book**—The answers to a power engineer's questions on coal scales are provided in this excellent 48-pp book, Bulletin 1143, covering scales for recording weight of coal consumed by individual boilers and weight of coal receipts from ship, car, truck or storage. It is generously illustrated with photographs of models and accessories and actual plant installations and contains all necessary engineering drawings, dimensional data and detailed specifications. Construction features and operation of weighing and feeding systems are described. Richardson Scale Co.

MISCELLANEOUS

249 **Pump Packings**—Packings for use on reciprocating and centrifugal pumps are illustrated by photo and described in this 4-pp folder. It covers packings for practically all services and includes a table of recommendations to facilitate selecting the right packing for any particular application. Johns-Manville.

250 **Industrial Insulation Catalog**—Mineral insulations for practically every purpose are covered in this 20-pp illustrated catalog. It describes in detail insulating cements for both high and low temperatures, high temperature block insulation, block finishes, felts, blanket insulation, pipe coverings, loose wool, weatherproofing and stack paints. Includes information and what each class of insulation is for, what it can be expected to do, how it's applied, how it's packaged and, in most cases, how much it costs. Discusses requirements of a good insulation and tells how these products meet the requirements. Forty-Eight Insulations, Inc.

251 **Cooling Towers**—Double-flow cooling towers are featured in 20-pp Bulletin DF. It discusses the principle of double-flow cooling, the mechanical equipment utilized, construction features of a tower of this type, water distribution, coil shed, and safety factors. Recommends sizes for different applications and includes photos of many installations. The Marley Co., Inc.

252 **Concrete Floors Q & A** — A new booklet titled Lumnite Concrete Floors—Corrosion Resistant and Heat Resistant, has just been published. The detailed information contained in this booklet brings up to date, the service experiences and late developments in this field. The information covers methods and materials used in placing corrosion resistant concrete in a wide variety of industrial applications. Typical uses of corrosion resistant concrete are listed for many industries and also given, are the answers to a number of questions often asked about it. A section on placing and finishing corrosion resistant floors will be helpful to prospective users. Lumnite Division Universal Atlas Cement Company.

CRUSHERS

253 **Coal Crushing, Sizing** — Bulletin 3007 describes the company's Bradford breaker a coal crusher, sizer and scavenger. The bulletin presents drawings of the breaker, tells how it works and then presents the complete story of its operation at the coal mine and coal cleaning plant at the By-Product Coke Plant and at the Power Station. The back section of the catalog presents engineering information on capacities, dimensions and dimensioned line drawings. Pennsylvania Crusher Company.

254 **Coal Crusher**—In this 8-pp bulletin a rolling ring crusher is presented as a solution to the problem of uniform stoker coal. Describes the special features of this crusher, emphasizing its shredder designed to split coal rather than crush it. Gives speed, capacity, weight and dimensions of available models and illustrates principle of operation. Also contains photos of parts and several complete installations. American Pulverizer Co.

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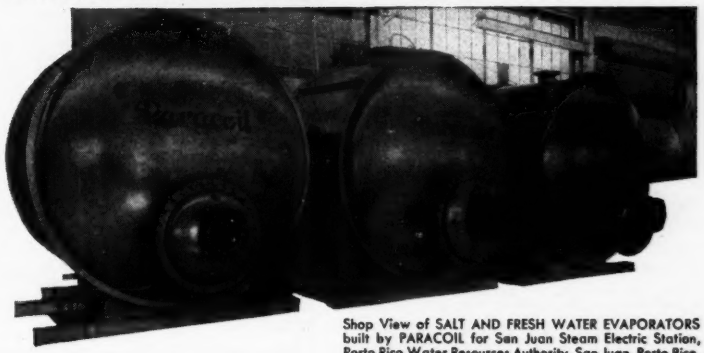

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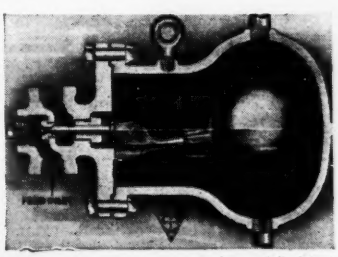

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1949 Supplement to Lincoln's Electrical Reference Book. By E. S. Lincoln, 113 pages, 8½ by 11 in. Paper cover. Published by The Electrical Modernization Bureau, 41 East 42nd Street, New York, N. Y.

When the first edition of Lincoln's Industrial Commercial Electrical Reference Book was published in 1941 it was intended to keep the book up-to-date by issuing monthly supplements. This proved impossible because of the war. However, a brief supplement was issued and sent to all registered book owners in September 1943. This supplement contained the National Electric Code changes issued in April 1943.

Since 1941 so many changes have taken place in the electrical industry that a new edition is being prepared and will be available in the Fall of 1949.

The Bureau feels, however, that registered owners of the first (1941) edition are entitled to a notation of the changes required to keep their book up to date. It is for this reason that this supplement has been prepared. It is somewhat brief and contains limited changes but brings the owners of the original edition the complete changes from 1940 to the 1947 National Electrical Code.

• • •

The Strange Story of the Quantum. By Banesh Hoffmann. First edition, 240 pages, 5½ by 8 in., cloth. Published by Harper & Brothers, 49 East 33rd Street, New York, N. Y., 1948. Price $3.00.

Those of us who went to school in the early years of the century may recall the confidence that we had in the wave theory of light. Light was a wave motion in a hypothetical medium known as the ether; it had been so proved. True, we knew something about Newton's earlier particle, or corpuscular theory as it was known, but that had been shown to be ill-founded, and after Newton's death the particle theory fell upon evil days. New experimental discoveries were overwhelmingly in support of the wave theory so that by 1900 it would have been almost heresy to suggest that there had been any valid reason for believing in the particle theory of light, Isaac Newton notwithstanding.

Yet, even then something had happened which was the beginning of a process that would in time so undermine the wave theory as to render it virtually obsolete. In 1887 Heinrich Hertz in his brilliant experiments which proved Maxwell's mathematical theory of the electro-magnetic character of light, had noticed a curious fact. He noticed that when ultra-violet light shone on the apparatus which produced his electric sparks, the sparks came slightly more readily.

It was a small thing and even though he noticed it, little could he realize that here within his grasp lay what still remains one of the clearest and most direct evidences we have for that strange realm of human understanding which now we call the quantum. The world was not yet ready to receive a gift so precious. The recognition of the quantum had to await the turn of the century, and when it came it was from a completely different quarter.

We now know how completely the quantum permeates all of existence. With the physicist it has become almost an obsession, haunting his every equation, dictating his every experiment, and leading him into long and not always fruitful argument with philosopher and priest on God and free will. Already its advent has revolutionized certain aspects of theoretical chemistry, and from chemistry it is but a short step to biology, the science of life itself. The quantum, therefore, deserves our most serious attention.

This book by Dr. Hoffmann gives the quantum that serious attention. The story of the quantum is the story of a confused and groping search for knowledge by scientists of many lands on a front wider than the world of physics had ever seen before, illumined by flashes of insight, aided by accidents and guesses, and enlivened by coincidences such as one would expect to find only in fiction. It is the story of a turbulent revolution; undermining of a complacent physics that had long ruled a limited domain, one marked for its destruction by its own inherent contradictions, and of the final emergence of a strange new concept—Quantum Mechanics.

Atomic bombs, cyclotrons and radioactivity, of which so much has been said and written in recent years, are only part of the story of atomic science. Behind them lie extraordinary ideas and stirring events without which our understanding would be meager indeed. This book tells the rest of the story of the lay reader.

It tells of the discovery of the quantum by Max Planck in 1900; how this discovery touched off as profound and exciting a revolution in science as ever experienced. It tells of Einstein's work—how Einstein decided that Planck's idea must be made even more revolutionary than Planck himself had dared to imagine. It explains how these ideas of Planck and Einstein revived and restored the particle theory of light and how later Heisenberg, Schrodinger and others—De Broglie—showed how the particle theory and the wave theory could be reconciled.

In short this is a great book, one which must be classed with the popular books of Eddington, and Jeans. Written for the general reader the book nevertheless makes demands upon the mental capacity of those who do not have some slight background of knowledge in this field. That, however, constitutes no excuse for anyone to pass it by.

Dr. Hoffmann is now with the Department of Mathematics of Queens College in New York. As a member of the Institute for Advanced Study at Princeton University he worked with Albert Einstein and published a research study in collaboration with him.

• • •

Thermodynamic Charts for Combustion Process, by H. C. Hottel, Glenn C. Williams, and Charles N. Satterfield; Part One—Text; Part Two—Charts; 75 pages plus 24 data tables and 8 folded charts. Plastic looseleaf binding; paper covered; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price: text, $2.60; charts, $2.40—total $5.00.

The new heat and power cycles are too complex for the conventional methods of thermodynamic analysis. It is no longer possible to assume that the working fluid is an ideal non-reacting gas, for the range of pressure, temperature and composition of the fluid in the new engines is too great. The Diesel cycle, the rocket, the ramjet and other similar cycles call for more exact methods of thermodynamic study.

These charts and accompanying text provide the tools to make this more exact analysis of heat and power cycles. The three authors are respectively, Professor, Associate Professor and Assistant Professor at the Massachusetts Institute of Technology. In the first part of the book they cover the principles of cycle calculation, then offer techniques for calculating the performance of a ramjet and of a tail pipe burner operating on the exhaust of a gas turbine. These techniques have never been published before. Then they present calculated techniques for many other cycles, including full-page charts covering all mixtures of carbon, hydrogen, oxygen and nitrogen.

The second part of the book contains 8 large charts for hydrocarbon air combustion and sets of tables giving thermodynamic properties and gas compositions for 80 mixtures.

• • •

Diesel Engines, by J. W. Anderson; Second Edition; 556 pages; illustrated; 6 by 9 in.; cloth binding; published by McGraw-Hill Book Co., Inc., 330 W. 42nd Street, New York 18, N. Y. Price $7.00.

This book aims to show the position of the Diesel engine in the United States today. It describes the various types of engines and classifies them. It discusses theory, design, the reasons why the several types and constructions are used, the proper application and installation of the engines with their accessories to suit the service requirements under different operating conditions, operation and maintenance of the equipment, the performance and service and operating costs. Finally, some suggestions are given to the purchaser to help him in choosing the proper engine for his requirements.

Design details are taken up first, then there is a chapter on automotive engines and another on industrial power engines, followed by one on marine engines. Stationary engines for hard continuous duty are then covered, next railway engines.

There is detailed treatment of scavenging, charging and super-charging, combustion chambers, fuel-injection systems, governors and safety equipment and cooling waters and lubricating systems. Starting systems are given one chapter and the book concludes with details of installation.

• • •

How to Solve Problems in Steam Power Engineering, by Stephen J. Tracy, Jr.; 152 pages; size 5½ by 8½ in.; paper binding; published by Thomas Y. Crowell Co., 432 Fourth Avenue, New York 16, New York. Price $1.25.

In 20 years of teaching engineering students, the author found a surprisingly large number of them have difficulty in applying their textbook theory to the solution of practical problems, particularly in the field of heat power engineering. The ability to apply theoretical knowledge to the solution of problems is usually the chief measure of mastery of a field. The present book, therefore, has been prepared specifically to meet this situation in steam power engineering. It provides comprehensive problems embracing the application of all the basic principles of steam power theory, together with complete step-by-step solutions for each phase of the subject, rather than mere variations of a limited set of data.

Part I shows solution of problems in the properties of steam; Part II problems in the steam-power cycle including the steam engine, the steam turbine, the reheat cycle, the regenerative cycle and the combined fluids cycle. Part III shows solution of problems in the steam generator such as, combustion, steam generation and heat balance. Part IV covers auxiliary steam power apparatus such as, pumps, condensers, heaters, evaporators, air preheaters, injectors and steam power plant piping.

Necessary explanations are given where required, together with diagrams and tables; and each chapter gives references to standard textbooks for further reading.

For any course in steam power engineering this should be a most useful and practical auxiliary book; and it should be especially valuable to the man who is trying to study steam power engineering by himself or by correspondence.

• • •

Engineering Data Manual for Water Cooling Problems; 72 pages; illustrated; size 8½ by 11 in.; paper binding; published by The Marley Co., Inc.; Fairfax and Marley Roads, Kansas City 15, Kansas. Price $1.50.

This is a handbook for engineers who encounter water-cooling problems and for operators who use water-cooling equipment. It is prepared under the direction of various officials of The Marley Co. It discusses first the properties and psychrometry of air; dry bulb and wet bulb design temperatures for typical U.S.A. and foreign cities; spray pond design data; air washer recommendations; dimensions and weights of standard pipe; and friction tables for cast iron, steel and redwood pipe.

Data are also presented on the terminology, fundamentals, operating terms and mechanics of atmospheric water cooling, as well as on tower design, selection, testing, operation and maintenance.

Data are also included on the heat absorbed by cooling water from various types of refrigeration units, compressors, condensers and internal combustion engines; and properties are given for refrigerants such as ammonia, Freon-12, methyl chloride and carbon dioxide, also calcium-chloride brine.

Structural data on lumber and its fastenings are used for cooling towers have been tabulated. Also wind-pressure data, fan laws and performance, noise measurement and sound analysis. Typical heat-flow diagrams for condensers, refrigeration and other processes are given and there is a section on water treatment to provide effective heat transfer in cooling equipment.

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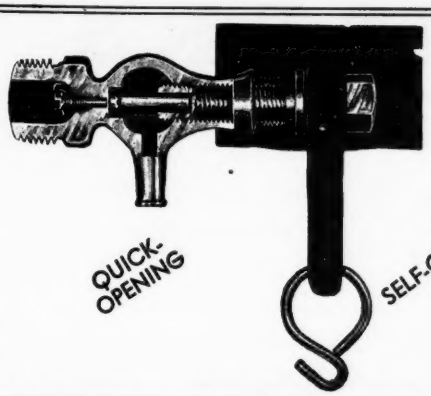
Papers Presented at the Seventh Short Course in Coal Utilization held at the University of Illinois, September 17, 1946; 192 pages; illustrated; size 6 by 9; paper binding. Published by the University of Illinois, Urbana, Ill. Price $1.00.

Papers Presented at the First Short Course on Hot Water and Steam Heating Systems held at the Undergraduate Division, University of Illinois, Navy Pier, Chicago, September 9, 1947; 108 pages; illustrated; size 6 by 9 in.; paper binding. Published by the University of Illinois, Urbana, Ill. Price 50 cents.

The purpose of the short course in coal utilization was to present an educational program of technical and practical information for those engaged in mining, marketing and using coal, as well as for those manufacturing and distributing machinery for the preparation and utilization of coal. Papers presented covered current activities in coal production and preparation; various phases of smoke prevention; coal storage; handling frozen coal; trends in heating service; economics of housing and heating costs; hot water needs and facilities; and discussion of consumer needs and preferences.

In the course in hot water and steam heating systems, papers were presented on heat loss calculations; flow of fluids through pipe; factors affecting comfort; types, locations, and performance of radiation; customer relations in the heating business; indirect heating of domestic hot water; pumps and controls.



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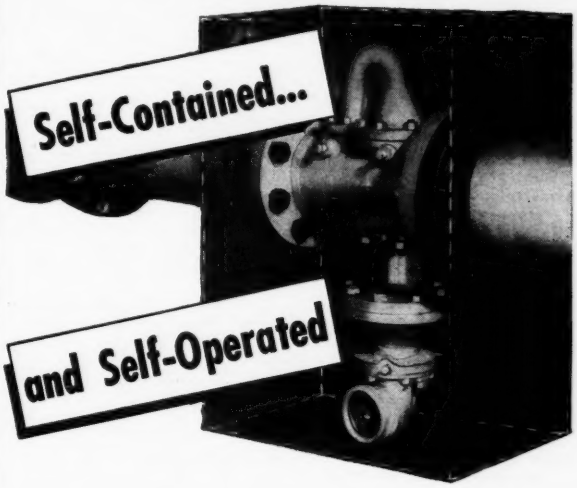

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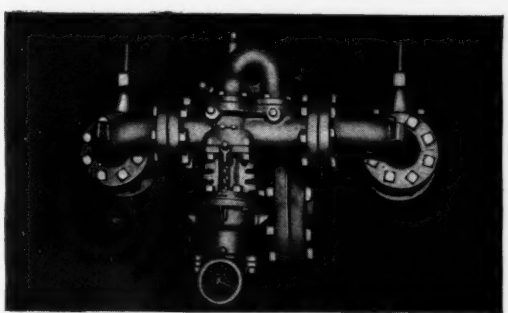

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Agency—Paul L. Kuch Advertising
Babcock & Wilcox Co., The 12-13, 31
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Builders-Providence, Inc. 129
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Cambridge Instrument Co., Inc. 132
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Chapman Valve Mfg Co., The ..... Inside Back Cover
Agency—Sutherland-Abbott
Cities Service Oil Co. 87
Agency—Ellington & Company, Inc.
Cochrane Corporation 109
Agency—Willard G. Myers Advertising Agency
Combustion Engineering-Superheater, Inc. 20-21
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Condenser Service & Engineering Co., Inc. 124
Crane Co. 43
Agency—The Buchen Company
Dampney Co. of America, The ..... *
Dart Mfg. Co., E. M. ..... *
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Davs Engineering Corporation 127
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DeLaval Separator Co., The 95
Agency—Donahue & Coe, Inc.
DeLaval Steam Turbine Co. 40, 126
Agency—Geo. H. Gibson Co.
Detroit Stoker Company 33
Agency—Witte & Burden
Dollinger Corporation 97
Agency—Casler, Hempstead & Hanford, Inc.
Dowell Incorporated 37
Agency—MacManus, John & Adams, Inc.
Dravo Corporation 101
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Drew & Co., Inc., E. F. 4
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Engineer Co., The ..... *
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Erie City Iron Works ..... 1[illegible]
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Ernst Water Column & Gage Co. 93
Everlasting Valve Co. ..... *
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Agency—Armstrong Advertising Agency
Foster Engrg. Company 91
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Fuller Company 116
Agency—O. S. Tyson and Company, Inc.
Garlock Packing Co., The 38
Agency—Hutchins Adv. Co., Inc.
General Coal Company ..... *
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Gifford-Wood Co. 19
Agency—O. S. Tyson and Company, Inc.
Golden-Anderson Valve Specialty Co. 129
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Goodall Rubber Co., Inc. ..... *
Agency—George C. Taylor
Grinnell Co., Inc. ..... *
Agency—Horton-Noyes Co.
Griscom-Russell Co., The ..... *
Agency—Michel-Cather, Inc.
Hagan Corporation 22
Agency—Ketchum, MacLeod & Grove, Inc.
Hall Laboratories, Inc. 14-15
Agency—Ketchum, MacLeod & Grove, Inc.
Hays Corporation, The 120
Agency—Gebhardt & Brockson, Inc.
Huyette Co., Inc., The Paul B. 129
Ingersoll-Rand Co. ..... *
Agency—Rickard and Company, Inc.
International Nickel Co., Inc., The ..... *
Agency—Marschalk & Pratt Co.
I-T-E Circuit Breaker Company 121
Agency—Richard A. Foley Advertising Agency, Inc.
Jefferson Union Co. 124
Johns-Manville 110
Agency—J. Walter Thompson Company
Kellogg Co., The M. W. ..... *
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Agency—Walter S. Chittick Company
Monsanto Chemical Company 49
Agency—Gardner Advertising Company
National Aluminate Corporation 34, 126
Agency—Armstrong Advertising Agency
National Valve & Mfg. Co. 117
Niagara Blower Co. ..... *
Agency—The Moss-Chase Company
Nicholson & Co., W. H. 122
Agency—Wilbur A. Myers
Northern Equipment Company 51
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Roto Div. of Elliott Co. 118
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Agency—W. L. Towne Advertising
Simplex Valve & Meter Co., The 104
Agency—Newell-Emmett Co.
Sinclair Refining Co. .... *
Agency—Morey, Humm & Johnstone, Inc.
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Agency—The Potts-Turnbull Co.
Standard Oil Co. (Indiana) 23
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Stets Company 127
Stone & Webster Engrg. Corp. 103
Agency—Harold Cabot & Co., Inc.
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Todd Shipyards Corporation (Combustion Equipment Div.) .... *
Agency—Wendell P. Colton Co.
Treasury Department 106
Troy Engine & Machine Co. .... *
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Agency—Roche, Williams & Cleary, Inc.
Unted States Rubber Company 6
Agency—Fletcher D. Richards, Inc.
United States Steel Corp. 108
Agency—Batten, Barton, Durstine & Osborne, Inc.
Universal Atlas Cement Co. (Lumnite Division) 108
Agency—Batten, Barton, Durstine & Osborne, Inc.
Vogt Machine Co., Henry 105
Agency—Farson & Huff
Warren Steam Pump Co., Inc. .... *
Agency—The Davis Press, Inc.
Western Precipitation Corp. 115
Agency—Dozier-Graham-Eastman Advertising
Wheeler Mfg. Co., C. H. .... *
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Agency—Price, Hedrick & Tanner, Inc.
Wiley & Sons, Inc., John 124
Agency—The Waterson Company
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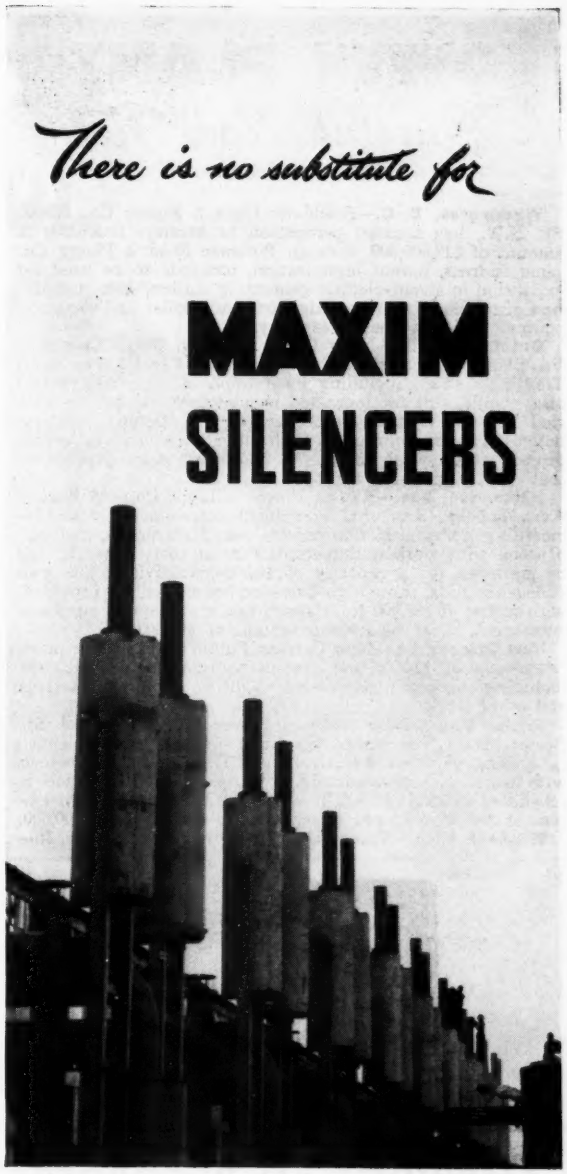

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POWER PLANT Construction News

Washington, D. C.—Braddock Light & Power Co., 929 E. St., N.W., has secured permission to arrange financing in amount of $13,000,000, through Potomac Electric Power Co., same address, parent organization, proceeds to be used for expansion in steam-electric generating station, with installation of turbine-generator, high-pressure boiler and auxiliary equipment for increased capacity.

Great Lakes, Ill.—Navy Dept., Pentagon Bldg., Arlington, Va., plans addition to main power plant at Great Lakes Naval Training Center, including installation of new boilers and other equipment for increased capacity. Work will be carried out under direction of Secretary of Defense, address noted above, in conjunction with other improvements, entire project estimated to cost about $1,575,000. Appropriation in that amount is being arranged.

Hutchinson, Kan.—Kansas Power & Light Co., 808 Kansas Ave., Topeka, Kan., has completed plans for new steam-electric generating station on site near Hutchinson, and will proceed with work on superstructure at early date. It will be equipped for a capacity of 40,000-kw, divided into two 20,000-kw units; three high-pressure boilers will be provided, with rating of 270,000 lb of steam per hr, complete auxiliary equipment. Cost reported in excess of $6,500,000.

New Orleans, La.—New Orleans Public Service, Inc., plans extensions in plants and system to cost about $5,125,000, including increased generating facilities, power substations and other work.

Salem, Mass.—New England Power Co., 441 Stuart St., Boston, Mass., has completed plans for new steam-electric generating plant on waterfront at Salem, and will proceed with work on superstructure at early date. Completion is scheduled in 1952. It will be equipped for a capacity in excess of 200,000-kw, and is reported to cost over $20,000,000.

Blissfield, Mich.—Village Council plans extensions and improvements in municipal steam-electric power plant, with installation of additional equipment for increased capacity. Cost reported close to $300,000.

Jackson, Mich.—Consumers Power Co., Jackson, will begin work early next year on new steam-electric generating station on Lake Erie, to be equipped for an initial capacity of 170,000-kw, divided into two 85,000-kw units, with high-pressure boilers and auxiliary equipment. First unit is expected to be ready for service in 1952, and second generator shortly thereafter. Cost reported over $15,000,000, with switching station, power substations, transmission lines and other operating facilities.

Meridian, Miss.—Mississippi Power Co., Gulfport, Miss., has plans maturing for proposed new steam-electric generating station in vicinity of Meridian. Work is scheduled to begin in October. Cost estimated about $5,500,000, with turbine-generator, boilers and auxiliary equipment.

Dover, N. J.—New Jersey Power & Light Co., 9 West Blackwell St., has authorized fund of about $5,000,000 for increased generating capacity at different plants during next 36 months, concluding in 1951, with installation of new turbine-generators, high-pressure boilers and accessory equipment.

Euclid, Ohio—Lincoln Electric Co., 12818 Coit Rd., Cleveland, Ohio, welding machines and parts, plans boiler house at proposed new plant at Euclid, where tract of 65 acres of land has been acquired. It will comprise a main one-story building and several auxiliary units, totaling 850,000 sq ft floor space in all. Entire project reported to cost over $8,500,000.

McConnelsville, Ohio—Ohio Power Co., 301 Cleveland Ave., S.W., Canton, Ohio, plans new steam-electric generating station on Muskingum River, near McConnelsville, where site is being acquired. It will be equipped for a capacity of 300,000-kw, and is reported to cost over $30,000,000, with switching station, power substations, transmission lines and other operating facilities. Company is a unit of American Gas & Electric Co., 30 Church St., New York, N. Y.

Middletown, Ohio—Armco Steel Corp. plans extensions in power plant, with additional equipment and facilities, in connection with expansion in East Works, comprising several 1- and multi-story buildings. Entire project is reported to cost approximately $12,000,000. Proposed to begin work at early date.

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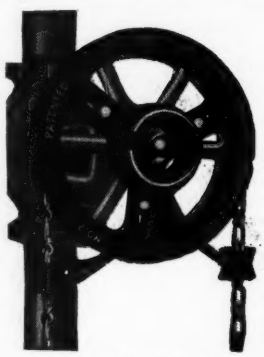

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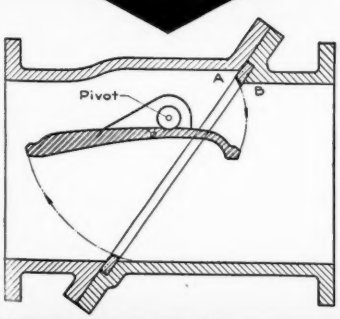

Cross-section of the Chapman Tilting Disc Check Valve illustrating the way that the balanced disc is supported on the pivot, with arrows showing the travel of the disc. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

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Write for full details to The Permutit Company, Dept. PG-9, 330 West 42nd Street, New York 18, N. Y., or to the Permutit Company of Canada, Ltd., Montreal.

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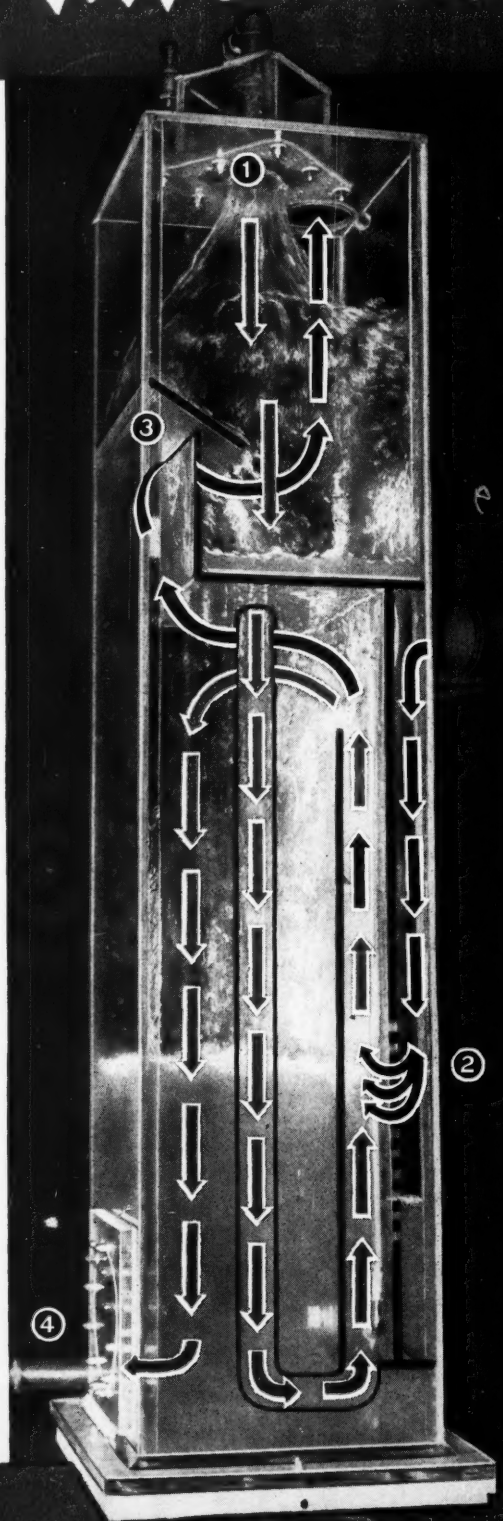

1 FIRST STAGE. Cold water, entering here, is heated almost to steam temperature by *spraying* it through steam. This removes 95% of the oxygen. The water then travels downward through the pipe toward the second stage.

2 SECOND STAGE. Here the partially deaerated water is intimately mixed with steam entering through the scrubber. Violent boiling and vigorous scrubbing is assured for both light and heavy loads, and deaeration is completed.

3 The steam from the scrubber travels upward and enters the first stage of the heater, where it partially deaerates incoming water. The remaining steam is then vented to the atmosphere.

4 Here the completely deaerated water settles and may be drawn off. Ample water storage space is provided below the water control level.

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